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MANUFACTURING

AND

MECHANICAL INDUSTRIES,

OF

WORCESTER.

WRITTEN BY

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WORCESTER, MASS.

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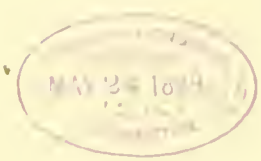

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MANUFACTURING AND MECHANICAL INDUSTRIES.

Early Encouragement of Manufactures—Saw and Grist-Mill—The Silver-Mine—Potash—Timothy Bigelow—Early Manufacture of Cloth—Paper-Mills—Character of Business prior to 1820—Trades-people Discontented with the Heavy Taxes—Public Men appear in Home-made Cloth—Worcester Honorable Society—The First Exhibition of the Worcester Agricultural Society.

I am indebted to the American Antiquarian Society for access to its valuable collection of books, pamphlets, newspapers and manuscripts, and to Mr. Edmund M. Barton, the librarian, for many courtesies. I have drawn freely from the files of the *Spy* and make the acknowledgment here to save frequent repetition in the text.

C. G. W.

AFTER the first settlement of Worcester had been broken up by the Indians in King Philip's War, a meeting of those interested was held at Cambridge, March 14, 1679, N.S., for the purpose of considering the expediency of again settling the town.[1]

As a result of this meeting, it was resolved "to settle the said plantation some time the next summer come twelve months, which shall be in the year of our Lord 1680."

The town was to be built to attain six ends, which were enumerated, chief among them "the better convenity of attending God's worship," and the "better education of their children;" but provision was also to be made "for the better accommodation of trades-people."

Nothing of a practical kind was done looking toward the settlement until the General Court threatened to forfeit the grant unless the settlement were made; accordingly, an agreement was entered into April 24, 1684, with that end in view. It was voted that the plantation be divided into four hundred and eighty lots, three of these to be set apart for the maintenance of a saw-mill, and three for a grist-mill.

To the builders and maintainers of works promoting useful trades, and for a fulling-mill, when the place is capable thereof, six lots.

The histories appear to agree that Captain John Wing built the first mills in Worcester, some time in 1685, perhaps in the month of March; he probably had both a saw and grist-mill located on the north of Lincoln Square, on Mill Brook, about where the Nashua freight depot is now situated.

Captain Wing appears to have been a man of considerable consequence. He was a resident of Boston, one of the founders of the Old South Church, an officer in the artillery company and kept the Castle Tavern. He was a member of the committee having charge of the plantation of Quinsigamond, and became a large landholder there, conducting his mill in Worcester and his tavern in Boston at the same time. He died in 1702.[2]

From 1686 till the fall of 1713 no records appear of the transactions which took place in the settlement, and during a great part of that time the country was exposed to the ravages of the Indians, and, in consequence, the town was almost entirely deserted.

The third attempt to effect a permanent settlement was made in October, 1713; the old saw-mill of Wing appears under the ownership of Thomas Palmer, Cornelius Waldo, of Boston, and John Oulton, of Marblehead.

The next mill to be built was that of Obadiah Ward, which he devised to his son in his will dated December 16, 1717. It was near the upper canal-lock, present site of Crompton's Loom Works.[3]

Elijah Chase built the first corn-mill, near where the Quinsigamond Paper-Mills were afterwards erected on the Blackstone River. The water privilege, with thirty acres of land at Quinsigamond, was granted by the town to Captain Nathaniel Jones, September 12, 1717, upon condition that he should complete and maintain a grist-mill for twelve years. He built a dam and saw-mill in 1726, but both were probably swept away in the flood of 1728–29, and in 1732 the town took steps to recover the land by reason of the failure of Jones to comply with his contract.[4] The mills in Worcester at this early period were few in number and simple in character. Saw and grist-mills, with an occasional fulling-mill and trip-hammer shop, were to be found; certainly the demands of two hundred people could not have been very great.

In 1754, according to a description found in Lincoln's "History,"[5] "a vein of metal, which was supposed to be silver, was discovered near the head of the valley, about a mile north of the town. A company for exploring the spot was formed by some of the most substantial inhabitants, furnaces and smelting-houses were erected and a cunning German employed as superintendent. Under his direction a shaft was sunk eighty feet perpendicularly, and a horizontal gallery extended about as far through the rock, which was to be intersected by another shaft, commenced about six rods north of the first opening.

"Among the masses which were, within a few years, laid around the scene of operations were specimens of the ores containing minute portions of silver, specks of copper and lead, much iron and an extraordinary quantity of arsenic; when struck against steel a profusion of vivid sparks were thrown out, and a peculiarly disagreeable odor of the latter mineral emitted. On the application of heat this perfume increased to

[1] Lincoln, p. 33.

[2] "Early Settlement of Worcester," by Francis E. Blake.

[3] Lincoln.

[4] "Early Paper-Mills in Massachusetts," E. B. Crane, Proceedings Worcester Society of Antiquity for 1886.

[5] Lincoln, p. 204.

an overpowering extent. The company expended great sums in blasting the rocks, raising its fragments and erecting buildings and machinery. While the pile of stone increased, the money of the partners diminished. The furnaces in full blast produced nothing but suffocating vapors, curling over the flames in those beautiful coronets of smoke which still attend the attempt to melt the ore.

"The shrewd foreigner, in whose promises his associates seem to have placed that confidence which honest men often repose in the declarations of knaves, became satisfied that the crisis was approaching when it would be ascertained that the funds were exhausted and that stone and iron could not be transmuted to gold. Some papers which exist indicate that he pretended to knowledge in the occult sciences as well as skill in the art of deception; however this may be, he assured the company that the great enemy of man had been busy in defeating their exertions, making his presence redolent in the perfume of sulphur and arsenic. He obtained the sum of $100 and made a journey to Philadelphia to consult with a person experienced in mines and their demons, for the purpose of exorcising the unsavory spirit of the crucible. He departed with a barrel full of the productions of the mine, but never returned to state the results of his conference.

"The proprietors abandoned the work when they were awaked by the reality of the loss from the dream of fortune, and afterwards destroyed the records of their credulity.

"The spot is easily found. Follow the Nashua Railroad north on foot from its crossing on Mill Brook till you pass the two-mile post. The deserted shaft is about twenty rods to the northeast of this spot. It is readily found, as a pile of slate and stones still lie where they were thrown out by the miners on a slight eminence in the meadow."[1]

And yet the German superintendent may have been more superstitious than knavish. The mineral which baffled him, whose arsenical fumes almost suffocated his miners and confirmed his belief in the supernatural, was cobalt, a name derived from Greek *Kobalos*, German *Kobold*, a little devil. German folk-lore is full of the diabolical pranks of the Kobold, and of pity for the unfortunate beings who suffered from the tortures which he inflicted to prevent incursions upon his subterranean dwelling.

Potash.—In 1760 the manufacture of potash appears to have been carried on quite extensively in and about Worcester; indeed, it was a thriving industry throughout the country. By reason of its scarcity in England, Parliament remitted the duties in 1751, and encouraged its importation from the colonies, where wood was plentiful. Numerous pamphlets upon the desirability of this branch of manufacture to the colonies, and upon the best methods of making potash, were at this time published.

Its manufacture was urged on the ground of affording the colonies an article of export with which to pay for the manufactures imported from Great Britain, and the North American plantations were thought to be well adapted to the manufacture of potash by reason of the abundance of wood suitable for the purpose. A writer upon this subject, in 1767, makes the following recommendations:

> It is supposed that each set of works for carrying on the manufacture of potash will have a range of ten miles round for its supply, less than which would not be sufficient, and I would here, by the way, caution such who may undertake to erect works for this purpose, that the place they fix upon be at least twenty miles distant from any other works of the like kind, lest they only injure their enterprise by thus cutting off the prospect of a sufficient supply of ashes.
>
> Each set of works under such advantages of obtaining stock will, I presume, at the least, annually produce twenty tons of good potash, which, at the lowest rate it has ever been sold for, namely, £25, would amount to £500 sterling, and if twenty of these works were to be erected within the limits of the province of Massachusetts (which I think a moderate number), there might be annually exported out of the province alone 400 tons of potash, which, at the before-mentioned low rate, would amount to £10,000 sterling.[2]

The process of manufacture was simple, and consisted in treating wood-ashes with water until the potash contained in them was exhausted, and from the lye thus made a salt was obtained by evaporation. The woods chiefly employed in making potash were hickory, oak, beech, birch, elm, walnut, chestnut and maple. Woods like evergreen, or that abound in turpentine, were avoided.

Worcester appears to have been well supplied with wood, and works for the manufacture of potash were established in different parts of the town. Pleasant Street was at one time known as Potash Hill. Lincoln, in his history, says: "Works for making potash were first established in the north part of the town about 1760; buildings for similar purposes were placed on the west side of Lincoln Street, a little above the old Hancock Arms Tavern, by John Nazro, about ten years after; four more were established at much later periods."

Peter Whitney, in his history, published in 1793, says: "The first complete ton of potash was sent to market from the neighboring town of Ashburnham, where it was made at the time of the settlement in 1735." In 1788 there were about two hundred and fifty potash works in Massachusetts. Governor Bowdoin, as a remedy for the distress then prevailing, had recommended in a message to the General Court, 1785, that the farmers in towns where there was an abundance of wood to be cleared away, should devote themselves to the production of potash and pearl-ash, and the ashes should be deposited with the State agent, who should sell them and use the money to pay the taxes of the men who brought them.

[1] "The Heart of the Commonwealth," Henry J. Howland, 1868.

[2] John Mycall's address to His Excellency Thomas Pownall, Esq., captain-general and Governor-in-chief in and over His Majesty's province of Massachusetts Bay in New England.

Isaiah Thomas, in 1793, advertised a book on the manufacture of pot and pearl-ash.

It has seemed worth while to dwell at some length upon the manufacture of potash, as it so clearly shows the narrow resources of the provinces at that time, and the lack of any manufacturing interests beyond the simplest kinds designed to meet the wants of a scanty population.

Timothy Bigelow.—One of the earliest mechanics to attain prominence in Worcester was Timothy Bigelow, who, before the Revolution, had a blacksmith's shop where the Court Mills afterwards stood, near the present junction of Union Street with Lincoln Square. Of him a somewhat romantic story is told.

There then stood on the site of the block of brick houses, opposite the court-houses, the residence of the orphan daughter of Samuel Andrews, then the principal heiress in Worcester. To quote from an old newspaper story:[1]

"In the rear of the Andrews home Tim Bigelow had a blacksmith's shop, where he blew the bellows, heated and hammered the iron, and shod the horses and oxen and mended the plows and chains for the farmers of the country about him. Now Tim was as bright as a button, more than six feet high, straight and handsome, and walked upon the earth with a natural air and grace that was quite captivating. Now Tim saw Anna, and Anna saw Tim, and they were well satisfied with each other; but, as he was then 'nothing but Tim Bigelow, the blacksmith,' the lady's friends, whose ward she was, would not give their consent to a marriage. So, watching an opportunity, the lovers mounted fleet horses and rode a hundred miles, to Hampton, in New Hampshire, which lies on the coast, between Newburyport and Portsmouth, and was at that time the 'Gretna Green' for all young men and maidens for whom true love did not run a smooth course in Massachusetts. They came back to Worcester as Mr. and Mrs. Timothy Bigelow.

"He was a man of decided talent, and well fitted by nature for a popular leader. All the leading men of the town at that time were Tories. He espoused the cause of the people, and soon had a party strong enough to control the town, and, being known as a patriot, he was recognized by Hancock, Samuel Adams, General Warren, James Otis and others of the patriot party throughout the Province. He was sent as a delegate from Worcester to the Provincial Congress, and, as captain of the minute-men, he led his company from Worcester to Cambridge on the 19th of April, 1775, at the summons of a messenger, who rode swiftly into town that day on a large white horse, announcing that war had begun.

"Blacksmith Bigelow soon rose to the rank of major, and, afterwards, to that of colonel of the Fifteenth Massachusetts Regiment, which was composed almost exclusively of Worcester County men. He was at the storming of Quebec, at the taking of Burgoyne, at the terrific scenes of Valley Forge and on almost every other field made memorable by the fierce conflicts of the Revolution.

"When the war was over he returned home, his constitution shattered by hard service for his country, his health ruined, his fortune gone in consequence of the formidable depreciation of the currency, under which forty dollars was scarcely sufficient to pay for a pair of shoes."

Cloth.—In 1789 a few men formed an association for the purpose of manufacturing cloths, that had theretofore been imported from Great Britain, and in the *Spy* of April 30, 1789, the following notice is found:

On Tuesday last the first piece of corduroy made at a manufactory in this town was taken from the loom; and March 25, 1790, the proprietors of the Worcester Cotton Manufactory gave notice that they would not take any more linen yarn for the present, having a sufficient quantity on hand.

May 27, 1790, Samuel Brazer advertises "goods of American manufacture to be sold at wholesale and retail, corduroys, jeans, fustians, federal rib, and cotton, for cash only. The prices are reasonable, the quality of the goods superior to those imported, which will induce all to give preference to the manufactures of their own country." Later, we find:

An Overseer wanted at the Cotton Manufactory at Worcester, also three or four healthy boys as apprentices; two or three journeymen weavers at said manufactory. Apply, for further information, to Saml. Brazer or Daniel Waldo, Worcester.

August 5, 1790, all persons who had demands against the proprietors of the Worcester Cotton Manufactory were requested to present them to Samuel Brazer and Daniel Waldo, Jr., from which we conclude that the enterprise had not prospered, and it is probable that upon the declaration of peace, goods could be obtained more cheaply from England than they could be manufactured here.

This factory, containing crude machinery, stood upon Mill Brook, and was located in School Street, east of the present location of Union Street.

When the manufacture of corduroys and fustians was abandoned, the factory was moved to Main Street, and was thereafter known as the Green store (present site of Parker block). Samuel Brazer was from Charlestown, where he was a baker, and in 1782 engaged in the same business in Worcester; he appears to have been somewhat jealous of his good name, for in 1784 we find him refuting a slander in regard to the size of his bread. In October, 1785, he dealt in crockery and West India goods at the sign of The Old Maid, in the centre of the town. From this time on Mr. Brazer was engaged in a variety of occupations.

Daniel Waldo, Jr., who was associated with Samuel Brazer in the manufacture of corduroys, was a son of Daniel Waldo, who moved to Worcester from Lancas-

[1] "Curl's Tour in Main Street."

ter in 1782, and engaged in the hardware business near the bridge over Mill Brook at Lincoln Square.

PAPER-MILLS.—The manufacture of paper took an early and prominent place among the industries of the Colonies.

May 3, 1775, at a convention of delegates from towns in Worcester County, the following vote was passed:

Resolved, That the erection of a Paper-mill in this county would be of great public advantage, and if any person or persons will undertake the erection of such a mill and the manufacture of paper, that it be recommended to the people of the county to encourage the undertaking by generous contributions and subscriptions.

In the *Spy* of July 5, 1775, the following notice is found:

Any person or persons that incline to set up that useful manufacture, the making of paper, may hear of one who will undertake to give direction for building a mill, and will carry on the business in good shape with assistance.

From the pamphlet on "Early Paper Mills in Massachusetts," by Mr. E. B. Crane, and part of the Proceedings of the Worcester Society of Antiquity for 1886, we learn that Mr. Abijah Burbank, of Sutton, was the first to respond to this resolution.

Paper was evidently very scarce, for we find that for want of it but one-half of the *Spy* could be published October 30, 1776. This was no doubt due to the scarcity of rags, which evidently continued for some time, for on October 30, 1777, the following notice was published:

The paper-mills and, of consequence, the printing offices in this county must inevitably stop unless the good people are more careful in preserving their rags. The advanced price of 3*d* per lb. for clean linen rags is now given by the printers, which, together with the invaluable benefit which the public must derive from having a plentiful supply of paper for books, cannot fail of the desired effect.

This difficulty seems, however, to have been overcome, for in May, 1778, Mr. Burbank advertised,—"The manufacture of paper in Sutton is now carried on to great perfection."

The business of Isaiah Thomas as printer and publisher in Worcester had become of considerable consequence. The Rev. Peter Whitney stated that no person had added more to the consequence and advantages of the town and county of Worcester than Isaiah Thomas. The publishing of the *Spy* was only a part of his business. After the war, in 1788, he conducted a printing-office in Boston and in Worcester, and carried on a large business as printer, publisher, bookseller and bookbinder.

Mr. Thomas lived on the site of the stone court-house, just south of which his office was located. He employed in the various departments of his business one hundred and fifty hands.

To provide paper for his needs, Mr. Thomas, to quote from Mr. Crane's pamphlet, "presumably with the intention of erecting a paper-mill, on January 7, 1785, purchased of Ephraim McFarland, for ninety pounds, the southerly half of a dam and water privilege located at what is now known as Quinsigamond village, and on the northerly side of the street, in front of the site now occupied by the Washburn & Moen Manufacturing Company's Mills.

"Owing, perhaps, partly to the unsettled condition of the affairs of state, and to the impoverished plight of the country, the building of the mill was deferred, and November 9, 1787, he sold the property for eighty-five pounds to Dr. Elijah Dix, from whom he again purchased it January 31, 1793, for one hundred pounds, and soon began the construction of a two-vat mill"; and, to again quote from Mr. Crane, "This mill, built by Mr. Thomas, was supplied with two vats of about one hundred and ten lbs. capacity, and they ran usually fifteen hours each day, employing ten men and eleven girls. The main product of this mill was hand-made paper, and from twelve hundred to fourteen hundred lbs. were turned out weekly." As to price of labor: The skilled engineer received about three dollars per week, vat-men and coucher three and a half dollars each without board; ordinary workmen and girls, seventy-five cents per week each; boys, sixty cents each, and they were given board.

It was here at this mill that Mr. Zenas Crane, a native of Dorchester, toiled at the trade of paper-making for several years previous to the summer of 1799, when he set out from Worcester to establish, in company with Henry Wiswell and Daniel Gilbert, a paper-mill in the western portion of Massachusets, and succeeded so admirably in laying the foundations for a business that, through the careful and skillful management of Mr. Crane and his descendants, has assumed the most flattering proportions, and whose trade-marks, known as "The Old Berkshire," "Old Red Mill," "Pioneer Mill" and "Government Mill," stand for as good an article of paper as can be found in this country or perhaps any other.

Mr. Thomas sold his paper-mill to Caleb and Elijah Burbank, of Sutton, February 24, 1798. This paper-mill was the second in the county and the eighth in the State. Another building was erected shortly after 1811, below the Thomas Mill, and used as a sickle-factory by Gardner Burbank, Elijah's son; afterwards it was converted into a paper-mill. This building was located in what is now the scrap-yard of the Washburn & Moen Manufacturing Company.

In 1778 the principal articles, aside from food and the ruder kinds of cloth, were imported, and mostly from England. The resident of Worcester could find steel, bar iron, choice brandy, New England and West Indian rum, coffee, alum, brimstone, powder and shot at the store of Samuel & Stephen Salisbury, on the north side of Lincoln Square, just east of the Salisbury mansion, where the depot now stands.

Elisha Clark, at this time, followed the business of rope-making about two miles from the meeting-house, on the road to Sutton.

Clock and watch-work was done in a small way, but not of a very fine grade, if we may judge from the following description of a watch supposed to have been stolen: "A large old-fashioned watch with the

glass broken in three places and put together with putty."

As a rule, shoemakers in the early days went from house to house, but in 1779 Nathan Heard appears to have established a small shoemaker's shop in Worcester.

Daniel Waldo, to whom reference has been made, opened, in 1782, a store near the bridge over Mill Brook at Lincoln Square, where he offered for sale best Heart and Club German steel, bar iron, 4dy. and 10dy. nails, window-glass, Dutch looking-glasses, iron shovels, spades, saddlers' ware, and in general, an assortment of hardware and West India goods, choice Bohea tea, etc.

The firm of D. Waldo & Son, dissolved December 31, 1791; Daniel Waldo, Jr., continued.

In 1783, Abel Stowell manufactured clocks and watches in his shop south of the meeting-house, on the west corner of Park and Salem Streets. He made in 1800 the clock formerly in the Old South Church. The business of watch and clock-making appears to have been a considerable industry at this time. Benjamin Willard, of Grafton, who had an office with Isaiah Thomas, had sold two hundred and fifty-three eight-day clocks up to 1784.

The art of hat-making was early practiced in Worcester; John Smith offered one shilling each for catskins in 1782, and in 1789 Nathan Blackburn advertises for an apprentice in the hat-making business.

In 1789 Palmer & Daniel Goulding owned a tan-yard. Almost every town had a tan-yard, and leather of sufficiently good quality was made to serve the needs of the shoemakers and saddlers in the immediate vicinity.

Improvements in the simple conveniences for living were made from time to time, and in 1791 the appreciation of the necessity for a cheap and satisfactory artificial light is found in the construction of a new candle machine,—price, forty-five dollars,—with which it was claimed a boy could make three hundred and sixty rods of candles per day.

Abraham Lincoln had a trip-hammer and grist-mill a few rods from the court-house, which he offered for sale in 1795. It must have been located on Mill Brook. The works are described as containing two pairs of bellows that go by water, a grindstone and mill all under one roof; "said works and grist-mill are as convenient and as well situated for custom as perhaps any in the Commonwealth."

The desire for communication between the seaboard and Worcester appears to have been felt previous to March, 1796, when some persons formed an association at Providence for making a canal to Worcester, and they were at that time invited to a conference in Worcester at the tavern of Ephraim Mower. Later on, no doubt as a result of this meeting, a prospectus appeared setting forth the purpose of the Canal Company, which was to issue four thousand shares of stock at one hundred dollars each, which it was estimated would cover the cost of building the canal. Subscriptions were solicited in Worcester; William Paine (at Dr. Lincoln's store), Joseph Allen (at his office), Isaiah Thomas, Thomas Payson, Daniel Waldo, Jr., and Samuel Chandler were appointed to receive them.

In October, 1796, a number of individuals petitioned the General Court for an act of incorporation for the purpose of cutting a canal from Great Pond in Worcester to Boston, but nothing was done at this time either with the Blackstone Canal or with the proposed canal to Boston. In 1822 surveys were made for the Blackstone Canal, which was afterwards put into successful operation, as appears later in the narrative.

In 1798 Daniel Denny had a card-factory on Mechanic Street near Main, opposite Mower's tavern (present site of Walker's building); later, he moved to Main Street, opposite present site of Bay State House. He, no doubt, bought his wire of Daniel Waldo, who imported it, and who, at this time, announced "Sixteen casks of Wool and Cotton Card wire will be landed in a few days from the brigantine 'Aidar,' just arrived from Amsterdam."

Dutch plows, made in Connecticut, were at this time for sale at Denny's store.

Cornelius Stowell, the clothier, had, in 1785, a shop on the east corner of Park and Orange Streets. Abel (the clock-maker), Peter and Ebenezer were his sons. The two latter he took into partnership with him about 1790, when they began to manufacture woolen goods, print calicoes, carpets, dye and dress woolen goods. They had two fulling-mills, and dyed fine scarlet and deep blue colors in the best manner.

In 1804 Peter & Ebenezer Stowell commenced to weave fine carpets, and at one time had six looms of their own invention and construction in operation. They made the first carpets used in the State-house at Boston. July 19, 1809, a patent on wood screws was granted to Abel Stowell, and in January, 1816, he and his son were located on the Common, a few rods southwest of the Baptist meeting-house, where they conducted a miscellaneous business, dealing in stoves of cast and sheet iron, with their funnels, "as cheap as they can be purchased in Boston or any other place." Machinery of all kinds in brass and iron, particularly such as are used in carding and other factories; clocks for meeting-houses and printers' materials in iron and brass. Among his effects offered for sale by his administrators in May, 1819, was an undivided part of what is called the Black Lead Mine, consisting of two acres. This was, no doubt, what was later known as the Worcester Coal Mine. Black lead was procured here and ground into a paint, which was quite generally used.

In January, 1808, Curtis & Goddard were busy making chaises, and at this time appear to have moved from opposite the jail to a building south of

the bank. Samuel Newhall had taken the noted stand of John Johnson, where he intended carrying on the soap-making business. Thomas Stevens, cabinet-maker, states that he has purchased the right to make and sell two kinds of churns for several towns in the county.

In May, 1810, John Earle and Erasmus Jones erected a wool-carding machine to pick, break and card wool at the building known as Lincoln's Trip-hammer Shop, fifteen rods east of the court-house.

At this time the number and variety of manufactures in Massachusetts appear to have increased considerably. Some idea of these, in 1810, may be had from a notice issued from the marshal's office in Boston July 17th, asking for information in regard to the following industries: tanneries, distilleries, sugar refineries, breweries, paper-mills, oil-mills, snuff-mills, chocolate-mills, gunpowder-mills, glass-works, fulling-mills, carding-machines (going by water), hemp and flax spinning-mills, cotton and wool-spinning mills, rope-walks, furnaces, air furnaces, forges, bloomeries, rolling and slitting-mills, cut-nail factories, trip-hammers and steel-furnaces.

The sudden increase in the variety of manufactures may be attributed to the embargo, declared in December, 1807, and to the complications then existing between this country and France and England, which led to an almost complete stoppage of importations, and manufactories of cotton goods, woolen goods, iron, glass, pottery and other articles rapidly sprung into existence.

Previous to the embargo, according to Hildreth,[1] there were in the United States but fifteen cotton-mills with a total of eight thousand spindles. By the end of 1809 eighty-seven mills were built, of which sixty-two were in operation—forty-eight by water and fourteen by horse-power—working thirty-one thousand spindles, and many more were in process of erection.

Most of the saws used in Worcester in 1810 doubtless came from the works of Elijah Waters & Co., at Sutton, who kept on hand steel-plate and saw-mill saws of various sizes.

One of the earliest machine-shops in Worcester was that of Earle & Williams, in 1812, opposite the court-house, where they carried on the business of machine-making, and advertised for sale machinery for spinning cotton and wool, carding-machines, and brass castings. Their shop was destroyed by fire January 5, 1815.

In April, 1813, the attention of shoe and boot-makers is called to a new and useful improvement, secured by patent, for putting shoes and boots together with copper nails, without any sewing. The patentee announces that he will attend at Captain Mower's tavern in Worcester (the site now occupied by Walker's building) from the 12th to the 20th instant, for the purpose of selling patent right, and claims that the invention "has been proved to answer every purpose for beauty, ease and convenience, and vastly more durable, at a saving of about half the work, and remedies all the evils attending iron nails and woolen pegs."

In April, 1815, the Worcester Tannery is offered for sale. It is described as situated in the centre of the town, and is one of the most extensive and convenient establishments in the State, in perfect repair, and with all the accommodations and necessary tools for carrying on the business.

"Through the middle of the yard runs a large brook, confined by a very handsome stone wall. A few rods from the tan-yard is a building in which bark is ground by water, and in which there is a patent bark-mill, strong and well-constructed."

This is the tannery formerly referred to as owned by Samuel Johnson, and was located east of the present site of Exchange Hotel.

Some reason for the sale of the tannery may be found in the heavy taxes upon leather. The other tanneries in different parts of the county appear to have suffered, for no less than nine are offered for sale during 1816 and 1817.

The discontent of the workers and makers of leather, and others, finds expression in the following notice, which appeared May 31, 1815:

Shoemakers ahoy! Have you been at the Collector's and given bonds, with two sufficient sureties, to pay duty upon your work?

If you make a single boot or shoe above $5 value without giving bonds to secure the duty to Government, you do it at your peril, and are subject to a penalty of not less than $500!

What is your situation better than that of Virginia negroes? You must account for every pair of boots you make to the Collector. You must tell how much you ask for them, whom you make them for, and how many pair you make; and, to crown the whole, all this must be done under oath. No, that does not crown the whole; one thing more, whenever a custom or breaks, or runs away, or cheats you, in addition to the loss of the article itself, and the labor, you must pay the duty upon it to the Government! This is the crowning, the cap-sheaf.

Silversmiths, carpenters, jobbers, hatters, tailors, tobacconists, boat-builders, tin-men, blacksmiths, and ye mechanics and manufacturers of all articles and commodities of whatever name and nature, be ye also ready. A fine of $500 awaits you unless you comply with the provisions of those arbitrary, iniquitous laws passed by Congress the 16th and 27th February, 1815.

In May, 1815, Earle & Williams give notice that in addition to machinery for carding wool, they will have in operation, about the 1st of July, machinery for the spinning of wool, which can be spun at a rate greatly below the price of hand-spun. They also give notice, June 21st, that, in connection with Asa Mann, they have in operation, near Stone's tavern, south part of Leicester, machinery for carding wool.

Joshua Hale, at the same time, states that he has put his machines for carding wool and spinning cotton in most excellent order, and attends them himself; also that he has for sale cotton yarn made of cotton selected by himself in Savannah, which he warrants to be the best.

[1] Richard Hildreth's "History of the United States," Vol. III, p. 21.

In September, 1815, Thomas & William Stowell advertise that they have improved the building lately occupied for a wire-factory, one and a half miles south of the meeting-house, where they have put their works in the best order for dressing cloth, and are in readiness to meet any demands in their business.

It may be interesting to note, in passing, that at this time the postage to Boston, on single letters, was fifteen cents.

John W. Lincoln, in January, 1816, advertises all sizes of nail-plates from the Millbury Rolling-Mill Company. This company was established in the latter part of December, 1815, for the purpose of manufacturing nail-plates and rods.

William Hovey, June, 1816, advertises a double carding-machine in operation for custom work at his factory, one mile south of the meeting-house in Worcester, where merino wool is carded in the best manner.

October 2d he gives notice that he has taken George March into company with him, and that at Hovey's mill they will manufacture wool into cloth; price for spinning wool, three cents per skein.

At this time considerable interest was manifested throughout the country in manufactures, and frequent meetings were held for the purpose of devising means for their encouragement. A committee of the Legislature in New York urged that members of Congress be instructed to attempt to have the duties on woolen and cotton increased; urged the public officers to clothe themselves in American cloth, and that manufactures be exempt from taxation, and manufacturers from serving in the militia, and from other public duties.

It appears to have been quite popular at this time for American statesmen to appear in clothes of American manufacture. It is said that Henry Clay, when once in Millbury, was presented with a roll of blue broadcloth, the product of the mill of Colonel Sheppard, and Mr. Clay remarked that his next suit of clothes would show Congress what American manufacturers could do.

Daniel Webster also had a suit of clothes made for his use in Washington from cloth made by the Goodell Manufacturing Company, at Millbury, woven, very likely, upon looms made by W. H. Howard, of Worcester.

The following notice appears in the *Spy* of October 22, 1817:—

The Members of the Worcester Honorable Society, being prisoners for debt on parole, and deprived of the means of supporting themselves in prison, or their families at home, or of paying their debts, and unwilling their time and talents should be lost to themselves or to the public, hereby give information to their creditors and the good people of this vicinity that there are in the society those who can perform the business of farming, shoemaking, masons, clock and watch repairing, card making, mathematical and meteorological instrument making, painting and glazing, engraving, distilling, rope making, etc., and solicit a share of their patronage in the above-named kinds of business, which they can perform within the limits; and they engage they will promptly and faithfully attend to all business entrusted to them.

Worcester Gaol, Oct. 22, 1817.

This is interesting, as indicating the variety of small manufactures carried on in and about Worcester at this time, and as illustrating the unfortunate working of the law then in force, which deprived many worthy men of any opportunity of escaping from their misfortunes.

In October, 1819, the Worcester Agricultural Society gave its first exhibition. Among the Worcester exhibits of domestic manufactures were two pieces of kerseymere and one calf-skin, tanned and curried in two days by Reuben Wheeler.

Nine skeins of tow yarn, from thirty-three to thirty-eight skeins to the pound, spun on a great wheel by a lady in Worcester.

The judges noted with regret that no hoes, scythes, plows, wool, cotton and machine-cards were exhibited in a county which had long been distinguished for the manufacture of these articles, and, in their opinion, no cotton cloth sufficiently good was offered to be entitled to a premium.

CHAPTER II.

MANUFACTURING AND MECHANICAL INDUSTRIES.

Streams and Mill Privileges—Population of Worcester—Blackstone Canal—The Railroads—The First Expresses—The Old Coal Mine—Peat—Stage Lines.

The introduction of steam-power, the opening of the Blackstone Canal and the railroads, have made it possible for a large manufacturing city to grow where otherwise no considerable progress could have been made; for had it been necessary to depend altogether upon water-power, few large factories could have been located upon the small streams which constitute the head-waters of the Blackstone.

These streams, nevertheless, have played a most important part, affording means for starting manufactories which have since so largely developed in size and variety; while the increased demand for power has been met by the introduction of steam-engines, through whose medium the waters which formerly were directly applied to the water-wheels, and whose capacity was consequently limited, are now equal to any demands which may be made upon them. For these reasons the water privileges and streams deserve prominent mention in any account of the manufacturing industries of Worcester.

The Ramshorn stream, so called, rises in Ramshorn Pond, which lies two-thirds in Millbury and one-third in Sutton; it flows in a northerly direction and is joined by Kettle Brook in the northeasterly part of Auburn.

Kettle Brook rises in Paxton, is fed by Lynde and Parsons Brooks, flows in a southerly direction and joins the Ramshorn stream, as above stated; the united streams, known as French River, flow in a

northeasterly direction. At New Worcester, Tatnuck and Beaver or Turkey Brooks unite with French River, and the course becomes a little south of east. At this point the stream is known as Middle River for about a mile; Mill Brook then joins it, and from this point the river is known as the Blackstone.

Ramshorn Pond is owned by the manufacturers on the Blackstone River, who are assessed for all expenses and repairs. The pond and stream have a water-shed of nine thousand two hundred and fifty-five acres. There are five privileges on this stream, previous to its entering the town of Auburn, the third privilege being that occupied by the old shop of Thomas Blanchard, where the eccentric lathe was invented by him, and is of considerable historic interest. The sixth privilege, which is in Auburn, is known as Larned's village or Pondville. There was a saw-mill here as early as 1794; later a mill was built for the manufacture of woolen goods, which has since been used for worsteds. Pond & Larned formerly owned this privilege, which is now occupied by Kirk, Hutchins & Stoddard.

The seventh privilege has long been known as Dunn's Mills; here saw, grist and shingle-mills have been located at different times; plow handles, probably for Ruggles, Nourse & Mason, were at one time made here. The old mills were burned some time ago, and the privilege is now used for a shoddy-mill.

A mile beyond, Kettle Brook and Ramshorn stream unite, not far from the French meadows, on the left of the Norwich and Worcester Railroad coming from Auburn to Worcester.

Kettle Brook flows from a reservoir in Paxton, which was built and is owned by the mill-owners along the stream.

The first privilege is an old saw-mill, but little used and somewhat dilapidated, owned by the town of Leicester. The second privilege down the stream is what was known formerly as Mulberry Grove (now Mannville), and is at present utilized for the manufacture of satinets by the Mann Brothers.

The third privilege is what is known as Kent's, built by the father of Mr. P. G. Kent, of Jamesville, who first built a saw-mill, then changed it to a shoddy-mill, then into a satinet-mill, which is now run by P. G. Kent & Brother.

The fourth privilege is Bottomly's brick mill, built by him, and known as his third mill. It is now owned and occupied by E. D. Thayer, and utilized for the manufacture of satinets.

The fifth privilege is the Chapel Mill, built by Mr. Dickinson, now used for satinets.

The sixth privilege is called the Eli Collier Mill. This was also built by Mr. Dickinson, and is run on satinets.

The seventh privilege was the Watson Mill, used for the manufacture of broadcloth. It was burned some time ago, and has never been rebuilt.

The eighth privilege is the old mill built by Thomas Bottomly, an Englishman. This was one of the first mills built in this region, and is said to have been built before any of the mills on the stream. Mr. Bottomly was one of the pioneers in the broadcloth business, which he conducted at this mill for many years. It has been remodeled, and is now owned and run by George W. Olney. Mr. Hodges was Mr. Olney's predecessor.

The ninth privilege is one on which a mill was built by Thomas Bottomly for the manufacture of broadcloth, and was known as his "second mill."

Lynde Brook empties into Bottomly's Pond, and a short distance up this stream is the Worcester Reservoir. This mill has passed through several hands, and is now owned and occupied by Albert E. Smith, who makes woolen goods.

The tenth privilege was occupied by Robert Young for a saw-mill, which was afterwards changed into a satinet-mill and was washed away in the Lynde Brook disaster; it was then merged in the Ashworth & Jones privilege.

The eleventh privilege was formerly occupied by a grist-mill, built by a Mr. Adams, who sold it to Wadsworth & Fowler. The grist-mill was torn down and replaced by a satinet-mill, which, after some time, was sold to Ashworth & Jones, who erected there a handsome mill, one hundred and seventy by fifty feet, four stories high, which was run on beaver cloth. In 1886 it was purchased by Mr. E. D. Thayer, Jr., who carries on a large business in the manufacture of woolen goods.

The twelfth privilege was originally occupied by a shingle-mill, then by a paper-mill, which was changed into a satinet-mill; it then passed into the possession of Ashworth & Jones, who connected it with the privilege next above.

The thirteenth privilege is known as Darling's, and was first occupied by Solomon Parsons. It then passed into the hands of Mr. Darling. Satinets have always been made here.

The fourteenth mill is known as Hunt's. This was also built by Solomon Parsons, and sold to Bellows & Darling. Cotton batting was first made here, and then satinets. It is now run by a Mr. Butler in the manufacture of satinets.

The fifteenth is the Jamesville privilege, which Benjamin James bought of the heirs of the Burnett estate. It was originally a saw-mill in the woods. Mr. James bought soon after 1850 and built the factory, which he ran on hosiery till about 1860; he then changed to army cloth, and after that to fancy cassimeres. It was run up to the time of Lynde Brook disaster, when the dam was destroyed, the water plowing twenty feet beneath the dam. The mill was rebuilt and ran on cassimeres till about 1880. It passed through several hands, and finally came into the possession of P. G. Kent & Co., who enlarged the mill and now make satinets. There is

quite a village at this point, a chapel and depot. One hundred and ten hands are employed in the mill.

The sixteenth privilege is occupied by the Stoneville Mill.

The waters of Kettle Brook come into the Stoneville Pond at the end nearest New Worcester; at the other end a stream comes in which has been known as Young's Brook, and by other names. About a mile up this stream was an old paper-mill, erected about 1834 by Nathaniel S. Clark and Daniel Heywood. Kettle Brook with this stream carries the Stoneville Mill, now operated by the Stoneville Worsted Company in the manufacture of yarn for the carpet-mill of William J. Hogg.

In 1834 Jeremy Stone owned this mill; it then went into the possession of Edward Denny, next of A. L. Ackley, and later was changed from woolen to cotton goods.

John Smith bought the mill about 1858, and it was subsequently run by his sons—C. W. & J. E. Smith—for many years. About a mile from this point Mill Brook joins the Ramshorn stream, and thence proceeds through the French Meadows, and is known as the French River.

At the next privilege Mr. Trowbridge, grandfather of William T. Merrifield, built, in 1810, a mill for the manufacture of cotton yarns. There had previously been a saw-mill, and possibly a grist-mill at this point. At this time Joshua Hale was carding wool at the privilege now occupied by Albert Curtis, and the farmers were in the habit of taking their wool to Mr. Hale to have it carded and spun, and bought their yarn at Trowbridgeville, doing the weaving at their own homes.

Tatnuck Brook has a water-shed of eight thousand nine hundred and forty-three acres. Upon an old map, published in 1784, a trip hammer-mill, a corn-mill and a saw-mill are found upon Tatnuck Brook, within the limits of the town of Worcester. The first mill recollected by those now living is a saw-mill in Holden, owned by a man named Hall; this was prior to 1850. The second privilege was near the outlet of the present reservoir, where there was another saw-mill.

The third privilege was at Tatnuck. The fourth privilege was the old mill built in 1834 for David T. Brigham, in Tatnuck, near the bridge on the road to New Worcester; it is now used for making satinets. It was built by William T. Merrifield in 1834. The fifth privilege was Patch's saw and grist-mills.

The sixth privilege was a small mill, and the seventh, the upper privilege now occupied by the Coes Manufacturing Company. This and the lower privilege on Leicester Street are more particularly described in that part of this article which treats of the wrench business.

Tatnuck Brook was known at one time as Half-Way River, as the bridge at New Worcester was half-way from Boston to Springfield. On its tributary, Turkey or Beaver Brook, a saw-mill was located in 1784.

At the junction of Tatnuck Brook and Ramshorn Brook was the old original dam which was removed by Mr. Albert Curtis about 1845.

The privilege now occupied by factories of Albert Curtis and Curtis & Marble is described elsewhere.

Next to this privilege is the one occupied by the Hopeville Manufacturing Company, manufacturers of satinets. This was occupied by Thomas Sutton in 1831, where he put in the first iron water-wheel in the county. Sutton's original mill was burned in 1862. About 1848 there was a cotton-mill here run by S. H. Thayer. This was formerly known as Hornville, so called because, when the first mill was built, there was no bell, and the help were called to work with a horn.

The first mill located here was a grist-mill. Bigelow & Barber bought the privilege in 1853.

Next come the carpet-mills, once the location of White & Boyden's machine-shop, where Mr. Albert Curtis learned his trade. Hatch & Gunn here commenced the manufacture of broadcloth in 1827; they were the first in Worcester to make woolen goods throughout. Then comes the Wicks Manufacturing Company, who recently commenced the manufacture of worsted suitings.

The next privilege is the one now occupied by the Worcester Wire Company, which has been used as a manufacturing site for many years and for many different purposes.

Upon the map previously referred to published in 1784, North Pond is said to cover thirty acres of ground. John Pierce's map, 1795, gives the area of North Pond forty acres, and says that in that year there were in Worcester five grist-mills, six saw-mills, one paper-mill. Near where Mill Brook leaves North Pond there were situated, in 1784, two fulling-mills; just southeast of the court-house was a trip-hammer shop. Between the two and just north of Lincoln Square the old mill of Captain Wing was located in 1685. Then a grist-mill, probably on the site of the Crompton Loom-Works, and a saw-mill was located at Quinsigamond, with the statement that "there is soon to be a paper-mill."

Mill Brook has a water-shed of seventy-seven hundred and fifty acres. The first privilege below North Pond Dam was occupied by a cotton-mill built by George T. Rice and Horace Chenery, about 1830.

The second was a factory built by Frederick W. Paine for Washburn & Goddard, and occupied by them until 1834; then by Goddard & Parkhurst until 1838, when it was leased for a short time by Ichabod Washburn, and was later occupied by William Crompton until it was burned in February, 1844.

The third privilege was the old tannery privilege, originally built by Dr. William Paine, father of F. W.

Paine, for a grist-mill, which was run by the family for many years.

About 1836 N. Eaton & Co. had a paper-mill here. The Olivers, stove dealers, next used the privilege to grind black lead. In the fall of 1851 Mr. Samuel Warren purchased the property of Mrs. Oliver, and ran it as a tannery until 1885. Mr. Warren's ancestors on both sides for three generations were tanners. His main business was to supply the cardmakers with their leather. This water privilege has recently been purchased by Stephen Salisbury.

The fourth privilege is Grove Mill, where the late Mr. Stephen Salisbury built a wire-mill for Ichabod Washburn in 1834.

The fifth, Court Mills privilege. Abraham Lincoln had a trip-hammer shop here in 1795; Earle & Williams a machine shop in 1812, and a bark-mill was probably run in connection with the old tannery located just back of Exchange Hotel in 1815.

Before Court Mill was burned there was an old one-story building located here, used in 1828 by William Hovey for the manufacture of shears and straw-cutters. The basement of the new Court Mills was built of the stones which came from the old jail, which stood on the square facing the present depot.

Howard & Dinsmore took the first lease of the Court Mills, and were succeeded by Mr. Samuel Davis.

The sixth privilege was built by F. W. Paine, at the corner of School and Union Streets. It was occupied at first by a small wooden building, thirty by eighteen, two stories high; the basement was occupied by W. H. Howard, lead pipe manufacturer; the second story by Calvin Darby, who ran a carding-machine. Mr. Howard was bought out by Ichabod Washburn in 1822, and January 1, 1823, Mr. Washburn and Benjamin Goddard formed a partnership, and at the same time bought out Calvin Darby. They manufactured woolen machinery here until their removal to Northville, in 1831. March, Hobart & Co. succeeded them. The premises have been occupied by various parties from 1822 till the present time in the manufacture of woolen machinery, N. A. Lombard & Co. being the present owners.

The seventh privilege was called Flagg Mills, afterwards known as the Red Mills, and owned by William B. Fox.

The Red Mills were occupied by sash and blind and cutlery manufacturers, while from the same privilege was obtained power which ran the woolen-mill of Fox & Rice, on the other side of the street. This privilege was sold, and the site became part of the sewerage system in the mayoralty of James B. Blake.

The eighth privilege was occupied by the upper and lower paper-mills at Quinsigamond, later and at present by the works of Washburn & Moen Manufacturing Company.

The ninth and last privilege in Worcester was occupied by the Perry Grist-Mills, which were built in 1831.

Mill Brook has played an important part in the development of the manufacturing interests of Worcester, and three distinct privileges on this stream have been occupied by wire factories, while the first experiments of Ichabod Washburn were conducted at the present location of the Lombard Factory, on School Street. The first wire-mill was located at Northville, and later was moved down the stream to the Grove Mill privilege, and later still the Quinsigamond privilege was used for this business. Mill Brook is now condemned to the main sewer shortly after it leaves the works of Washburn & Moen Manufacturing Company, in Grove Street, from which it emerges into the Blackstone, just below the works at Quinsigamond.

It was not until 1820 that Worcester took first rank among the towns of the county. The census of 1765–76 gave Worcester the fifth place in population, following Sutton, Lancaster, Mendon and Brookfield. In 1790, 1800 and 1810 Worcester stood third in order, Brookfield and Sutton preceding.

In 1820 Worcester took first place, and from that time to the present has shown a constantly-increasing percentage of the population in the county. That percentage amounted to something over eleven per cent. for the decade ending 1830, and over fifty per cent. for the decade ending 1880; while of the increase (17,142) in the population of the county between 1880 and 1885, 10,098, or nearly fifty-nine per cent., belongs to the city of Worcester; and of the population of the county, which was 244,639 in 1885, Worcester had 68,389, or a little over twenty-eight per cent. In 1820 the population of Worcester was 2,962, and of the county 73,625.

This brings us to the time of the building of the Blackstone Canal between Worcester and Providence, which marks an important epoch in the progress of Worcester, and too much credit cannot be given its projectors for appreciating the necessity to Worcester of communication with the seaboard. It is true that the canal was never of great practical value, by reason of the better facilities for business afforded by the railroads. It is equally true that without the railroads the canal would have ensured the growth and prosperity of the town.

The plan of making a navigable water-way from Providence to Worcester was first suggested, in 1796, by Mr. John Brown, of Providence, and his associates, but the Legislature of Massachusetts, failing to assent to an act of incorporation, it was not then carried into execution.

In May, 1822, "Gentlemen who are friendly to the project of a canal from Worcester to Providence are requested to meet at Colonel Sikes' Coffee-house on Friday evening, at seven o'clock." Another meeting was held on May 24th, and a committee appointed,

upon which the following gentlemen served: Levi Lincoln, John Davis, John W. Lincoln, William E. Green, John Milton Earle, Edward D. Bangs.

In September, 1822, the surveys of the canal were completed. According to the report of the committee, the length of the canal would be forty-five miles and the descent from Thomas Street to tide-water in Providence 451½ feet.

The ground was bored every twelve rods for the whole distance, and upon the route selected no rock was found within the depth of excavation. The engineer reported, "I have come to the conclusion that a canal 32 feet wide at the top, 18 feet at the bottom and 3½ feet depth of water, would be a proper size to be formed, and that locks of 70 feet between the gates and 10 feet in width would be sufficiently large for the trade intended."

The estimated expense of the work, including locks, was $323,319.

The excavation in Rhode Island was commenced in 1824, and a meeting of the Blackstone Canal Company was called at the Thomas Coffee-House, Worcester, April 9, 1825, for the purpose of forming a corporation.

Great expectations were formed of the amount of business that would be done, and it was claimed that the canal would more than double the value of real estate within six miles of it. The subscription books for $400,000 of the capital stock, were opened in Providence, April 27th; three times the required amount was subscribed for, and the stock sold at a premium.

In May, 1826, the canal was located in the village of Worcester.

Fears were entertained in Boston at this time that the canal would divert trade from Boston to Providence; to counteract this, a plan for a railway between Worcester and Boston was proposed. It is related that a wag, happening to be in town when the account of the sale of canal stock was received, was asked what the Boston folks would do when they heard of that. "Oh," replied he, "they will rail a-way!"

The first canal-boat to arrive in Worcester was the "Lady Carrington," which arrived from Providence October 7, 1828, and moored in the basin in Central Street, at head of canal at eleven o'clock, and was advertised "To take passengers for Millbury to-morrow morning, returning in the evening, and she will remain here during the present week for the accommodation of parties."

The arrival of the "Lady Carrington," according to an account in the *National Ægis*, October 8, 1828, "was greeted on passing the locks by the cheers of the multitudes assembled. On reaching the Front and Central Streets bridges continued cheers hailed its approach. At eleven o'clock the boat arrived in the basin, and the commissioners and the crowd assembled were addressed by Colonel Merrick, chairman of the Board of Selectmen, who expressed the sentiments appropriate to the occasion. On the conclusion of his remarks, enthusiastic cheers, the thunders of cannon and the peal of bells welcomed the visitant to the town. The commissioners and other gentlemen of both States were passengers on the boat, and with the gentlemen of the town partook of a collation at the house of the Governor."

The following notice appears in the *Spy* at this time:

Port of Worcester, October 8, 1828. Arrived yesterday, Canal-boat "Lady Carrington," Captain Dobson, from Providence, with slate and grain for Nathan Heard.

At the end of October "Lady Carrington" arrived in Providence loaded with domestic goods—butter, cheese, coal and paper.

The following extracts, taken from the papers of the day, will give some notion of the amount and character of the goods shipped:

Canal-boat "Providence," Captain Dobson, with 10,000 lbs. lead pipe from T. & J. Sutton, machinery from William Hovey, and iron castings from Sumner Smith.

Departed, boat "Massachusetts" for Providence, with 26 casks of beer and 11 hogsheads from Trumbull & Ward.

Arrived, canal-boat "Worcester," Captain Green, from Providence, with 3457 lbs. of iron for Washburn & Goddard, 4169 lbs. of lead to J. & T. Sutton, 13 bales of cotton, 3 tons of logwood and one ton of copperas for William Buffum, Jr.

But there were three serious drawbacks to the prosperity and profits of the canal, which soon made it unpopular with most of its stockholders and patrons. Unfortunately, a portion of the canal was located in the Blackstone River, and boats were more or less delayed in high, and also in low water, and in some seasons for weeks were detained with goods which were wanted for immediate use or sale. In some years the canal was for four or five months closed with ice. In a season of drought the manufacturers were jealous of the boatmen drawing so much water, and on several occasions in Rhode Island the owners of the mills and of the water-power ordered large loads of stone tipped into the canal-locks to prevent the boats from passing, which almost excited a riot among the boatmen, and some of the mill-owners were afraid their mills would be fired, as they had been threatened.[1]

April 22, 1846, the *Spy* states that the canal company had sold all that portion of the canal in Massachusetts, with all the privileges and franchises, except the reservoirs, for the sum of twenty-two thousand five hundred dollars to the Providence and Worcester Railroad Company, and April 25, 1849, the locks, boats and water-rights were advertised for sale. The last toll was collected November 9, 1848, but meantime more efficient means of communication between the sea-board and Worcester was afforded by the railroads.

In March, 1831, subscription books were to be found at the banks, where those who wished could

[1] "History of the Blackstone Canal," by Colonel I. Plummer.

subscribe to the stock for a railroad from Boston to Worcester.

The Boston and Worcester Railroad Company was chartered June 23, 1831, to build a line from Boston to Worcester,—a distance of forty-four miles. A train was run through to Worcester July 1th; but it was not until July 6, 1835, that the road was formally opened, although the cars had, for some time previous, been running from Boston to Westboro', and, as early as April 16, 1834, to Newton. The train of July 6th to Worcester consisted of twelve cars drawn by two locomotives, and contained the president, directors, stockholders and invited guests to the number of about three hundred.

The train, which left Boston at a quarter before ten, arrived in Worcester at about one o'clock. It was met by a committee, of which Charles Allen was chairman; a procession was formed under the direction of General Nathan Heard, and proceeded to the Town Hall, where a collation was served and speeches made. At four o'clock the train started on the return trip to Boston.

At the Insane Asylum, when the first locomotive passed, one of the inmates remarked: "Well, that beats the very devil; I never before saw a critter go so fast with such short legs!"

In April, 1836, the business of the Boston and Worcester Railroad Company was said to have been more than double the amount of that of the corresponding time of the year preceding; passenger cars were well patronized, and there was more freight than the company was prepared to care for. During the first five months of 1837 the receipts were twenty-six thousand dollars more than during the same period in 1836, and continued to show a steady increase.

The Western Railroad Company was chartered February 15, 1833, to construct a line from the terminus of the Boston and Worcester Railroad to Springfield, and thence to the western boundary of the State. A mass-meeting was held in Faneuil Hall, Boston, October 7, 1835, to take measures to ensure the subscription to the capital stock of $2,000,000. This was accomplished, and the following winter the Legislature authorized a subscription of $1,000,000 in behalf of the State, making the capital stock $3,000,000. At this meeting Edward Everett made a speech, in which he insisted upon the importance to Massachusetts of "Communication with the West."

Trains commenced their regular trips between Springfield and Worcester October 1, 1839. The time occupied in making the journey was about three hours. A public dinner was given in Springfield in honor of the opening of the road, October 3, 1839, on which occasion Edward Everett said:

> Let us anticipate the entire completion of the work, with all its arms, a thousand miles in length. What a spectacle it will be! It will present to the vast region of the West a net-work of iron, one hundred miles long, its movable portion flying across the State like a weaver's shuttle. By the seaside in the morning, here at noon, and back in the compass of an autumnal day. And the power which puts all in motion, most wondrous, a few buckets of water! Did we live in a poetic age, we have now reached the region where the genius of steam communication would be personified and embodied. Here we should be taught to behold him a titanic colossus of iron and of brass, instinct with elemental life and power, with a glowing furnace for his lungs and streams of fire and smoke for the breath of his nostrils! With one hand he collects the furs of the arctic circle, with the other he snatches the forests of Western Pennsylvania. He plants his right foot before the source of the Missouri and his left on the shores of the Gulf of Mexico, and gathers in his bosom the overflowing abundance of the fairest and richest valley on which the circling sun looks down.

September 14, 1867, the two Massachusetts corporations were consolidated under the name of the Boston and Albany Railroad Company, and on December 28, 1870, a further consolidation was effected with the New York roads, thus forming the present organization.

The Norwich and Worcester Railroad Company was chartered in March, 1833. The first meeting of the company was held at Webster July 1, 1835. The length of the routes surveyed was a little short of sixty miles, and passed through thriving villages, while upon the banks of the adjacent streams there was said to be water-power sufficient to carry one million spindles; the number of cotton-mills was seventy-five and of woolen-mills twenty-seven, exclusive of Worcester and New London. There were said to be one hundred and forty manufacturing establishments between Norwich and Worcester, within five miles of the road. Though fifteen miles longer than the Boston and Worcester Railroad, it was estimated it would cost five hundred thousand dollars less. Regular trips between Worcester and New London commenced March 9, 1840, and the fare to New York by this route was fixed at five dollars.

R. W. Whiting, Nov. 21, 1838, advertises that, having made arrangements with the Boston and Worcester Railroad Co. to occupy a part of a car, to be run with the passenger train to Boston in the morning and back in the afternoon, commencing on Monday, 26th of November, he will take charge of all packages, bundles, etc., which may be entrusted to his care, and will see them safely delivered the same day, and that he will also transact with promptness any other business committed to his care.

He had an order-box at the Temperance Exchange, Railroad Depot and the American Temperance House, where he could be found after seven in the evening and before seven in the morning.

William F. Harnden has always been credited with being the father of the American Express system. His advertisement is found in the *Spy* of June 24, 1840, where he announces that the Worcester, New York, Philadelphia, Baltimore and Boston Baggage Express will commence July 1, 1840, running daily, and that he will forward in his express car daily, packages, bundles, etc., to and from each of the above-named places,—to Boston by steamboat-train

every morning, and to New York every afternoon at half-past four.

All packages must be marked Harnden's Express, and sent to his office, N. Tead's Hat Store, one door north of the Post-Office, Worcester. Simeon Thompson, agent, Worcester.

WM. F. HARNDEN, *Prop.*,
8 Court Street, Boston.

S. S. Leonard, in the *Spy* of August 12, 1840, advertises an express between Boston and Worcester.

September 2, 1840, Burke & Co. advertise the New York and Boston Baggage Express, *via* Norwich and Worcester, run by the subscribers, P. B. Burke & Alvin Adams. Packages to be left at J. B. Tyler's, Worcester.

The question of a railroad between Providence and Worcester, a distance of forty-three miles, was seriously discussed as early as 1837, but nothing was done for several years. In August, 1845, the enterprise came nearly to a stand-still, although eight hundred thousand dollars had been subscribed under the Rhode Island charter and one hundred thousand dollars under the Massachusetts charter; but the Rhode Island charter required that the whole capital of one million dollars should be taken up before the company could proceed. The amount was finally raised, and a consolidation was effected November 4, 1845, of the Massachusetts and Rhode Island Companies, each of which was chartered in 1844. The main line was opened in October, 1847, when a train, made up of nine covered cars and twelve or thirteen open cars, drawn by three powerful engines, arrived in Worcester with twelve hundred passengers from Providence and towns on the line.

The Worcester and Nashua Railroad Company, organized in November, 1846, was a consolidation of a company of the same name, chartered in Massachusetts March 5, 1845, and the Groton and Nashua Railroad Company, chartered in New Hampshire December 4, 1844. The road was opened from Worcester to Nashua, a distance of forty-six miles, December 18, 1848. The Nashua and Rochester Railroad Company was chartered July 5, 1867, and opened from Rochester to Nashua, a distance of forty-eight miles, November 24, 1874. William A. Wheeler was one of the principal promoters of the Nasbua Railroad, and was the superintendent of construction.

December 1, 1883, the Worcester & Nashua and Rochester Railroads were consolidated under the name of the Worcester, Nashua & Rochester Railroad Company, which company was leased to the Boston & Maine Railroad Company October 30, 1885, for fifty years from January 1, 1886.

The Boston, Barre & Gardner Railroad Company, running from Worcester to Winchendon, a distance of thirty-six miles, was chartered April 21, 1847, as the Barre & Worcester Railroad Company, and April 24, 1857, as the Boston, Barre & Gardner Railroad Company. It was opened to Gardner, September 4, 1871, and to Winchendon, January 4, 1874. It was taken posession of by the Fitchburg Railroad Company March 7, 1885, and merged in the latter company as a branch, July 1, 1885.

It will thus be seen that from an early day Worcester had the advantages of the best railroad facilities, and to this, and to the introduction of steam-power, is to be most largely attributed her rapid growth as a manufacturing city. At the present time there is not only direct communication with all points north and south, but there are five outlets and thirteen different lines, more or less, affording direct communication with the West. Edward Everett's wish, so strongly expressed in his speech in Faneuil Hall prior to the opening of the Western Railroad, is most perfectly fulfilled.

In 1823 attention is called to the advantages possessed by Worcester which should make it a large manufacturing centre. Encouragement is found in the fact that towns in the interior of England, with no greater local advantages, have contained from 10,000 to 15,000 inhabitants, and since the introduction of steam-power, a population of from 80,000 to 100,000 has been reached. It was stated that Worcester would soon be at the head of canal navigation, and in addition, her "inexhaustible store of anthracite coal, well calculated for steam-engines," was referred to as being of the greatest value.

Considerable attention was given in 1823 to the examination of the anthracite coal deposits, which were located northeast of the city, west of Plantation Street, and near its junction with Lincoln Street, now known as the Old Coal Mine.

The coal was said to be of the same variety as the Rhode Island, Schuylkill and Lehigh coal, and was found, according to statements then made, to ignite easier than any of them and to burn longer. Careful comparisons were made of the relative value of these different varieties and the result, with a given quantity of each, showed as follows:

Worcester coal lasted five hours; Lehigh, four hours twenty-five minutes; Rhode Island, three hours thirty-six minutes. The thermometer was raised by the Worcester coal to one hundred and seventy-nine degrees; by the Lehigh, to one hundred and sixty; by the Rhode Island, to one hundred and thirty-four.

The Worcester coal burned brighter than the others, and with more flame. It was confidently asserted that when the Blackstone Canal should be completed Worcester coal would be the cheapest fuel for Providence; it was estimated, however, that the Worcester coal was more impure than the Lehigh, containing a considerable portion of earthy matter that remained in the form of ashes after burning; but, in spite of this, it was thought that it would answer a valuable purpose. Tests were made at the Worcester Brewery, which appear to have been satisfactory, for in February, 1824, application was made to the General Court for the incorporation of the Massachusetts

Coal Company, to ascertain the quality and quantity of the coal, and expense of mining and conveying it to market.

For the next two years it appears to have been used as the principal fuel in the brewery of Trumbull & Ward, and was also used in Colonel Gardner Burbank's paper-mill. It was found there, that about half of the bulk of the coal remained after the fire subsided, but upon replenishing with new coal it was mostly consumed in the second burning, and Colonel Burbank found the expense of keeping a fire with this coal to be less than the expense of cutting wood and tending fire, if the wood were delivered at the door free of expense.

In December, 1827, the proprietors of the brewery burned coal taken from the land of William E. Green, which was a little distance from the mine, but appeared to be of a somewhat better quality

Work at the coal mine must have been prosecuted with some vigor, for in February, 1828, fifteen or twenty young men and a blacksmith were wanted to work there.

In November, 1828, an opening twelve feet wide and eight feet high had been carried into the hill about sixty feet, at a descent of about twenty-five degrees, and a railway was laid, on which the coal was carried from the mine to the place of deposit, in loads of fifteen hundred pounds.

In February, 1829, the Worcester Coal Company was incorporated, and in March, 1829, the Worcester Railway Company, with a capital of fifty thousand dollars, with authority to build a railway from the mine to Lake Quinsigamond and to the Blackstone Canal, but the enterprise appears to have been abandoned shortly afterwards. The coal was found to be too impure for economical use. It was somewhat humorously said that there was a d—— sight more coal after burning than there was before.

Peat was also found in the meadows about Worcester. In 1856 it was introduced into the Wire Factory as a substitute for wood and coal; in three years nearly two thousand cords were used in this way, and it was found that a cord of well-seasoned peat would produce as much heat as a cord of dry oak wood; and a cord and a half of peat would generate as much steam as a ton of anthracite coal.

It was estimated that peat could be used to good advantage for manufacturing purposes at a saving of from thirty-three and one-third to fifty per cent. over any other kind of fuel. It had the remarkable quality of keeping fire a long time, even burning for a week after the fire had gone down. In April, 1856, the Worcester Peat Company was formed, but no business of consequence appears to have been done by it. It was no doubt found that coal was the cheaper fuel.

In June, 1827, Worcester is spoken of as containing "the large paper-mills belonging to Elijah Burbank, five machine shops, at which great quantities of machinery of various kinds are made, one small Cotton factory, a Lead aqueduct factory and other works of minor note."

Prior to 1813 there was no stage or mail route between Worcester and Providence; in that year, or 1814, it was attempted to run a stage, but the business was only sufficient to support a cheap carriage and two or three horses, and the proprietors abandoned it.

Until 1819 the mail was carried once a week in a one-horse wagon; an attempt was then made to run a two-horse stage twice each week, but this did not pay, and was abandoned,

In 1823 a line of stages was started and well patronized.

For a long time the only stages from Worcester were six times each week to Boston, and six times each week to New York.

In 1827 there were eighteen different lines of stages running from Worcester, and the passengers averaged one hundred daily.

CHAPTER III.

MANUFACTURING AND MECHANICAL INDUSTRIES.

Textile Fabrics and Machinery for Making Them. Early Manufacture of Cloth—Condition of Woolen Manufacture—John Goulding—Manufacture of Cotton and Woolen Machinery. Card Clothing—Looms—Carpets. Thread.

WE have already noticed that Samuel Brazer in 1790 advertised to sell "corduroys, jeans, fustians, federal rib and cotton," and that at the same time he and Daniel Waldo were proprietors of the Worcester Cotton Manufactory. There was then scarcely any machinery for the manufacture of cloth in America; it had been introduced into England, but there were severe laws against its exportation to the colonies.

The process of making cloth, as early conducted, was entirely by hand-power. Hand-cards were used for straightening the fibre of the wool or cotton, which was spun by a single spindle driven by a wheel kept in motion by the hand of the operator. The yarn was woven upon hand-looms, and the cloth thus made was sent to the fulling-mill, which was the first branch of the business not conducted in the household.

Fulling-mills were scattered all over the country for the purpose of finishing the cloth made in the farm-houses.

John Earle and Erasmus Jones in 1810 "erected wool-carding machines to pick, break and card wool at the building known as Lincoln's Trip-hammer shop, fifteen rods east of the Court-house."

In 1811 William Hovey, an ingenious mechanic, advertised a new shearing-machine, called the "Ontario Machine," and warned all persons against making or using a machine embodying the principle on which this was constructed, "which covers a

spiral revolving shear working against a straight blade or cutter." One of the advantages claimed for this machine was that it could be carried anywhere in a one-horse wagon, and could be operated either by hand or water-power. It was claimed that this machine would facilitate that laborious branch of the business ten-fold.

Hovey constructed another machine in 1812, in which the shears moved across the cloth on the same principle as hand-shears, and he claimed that with this machine he could shear about two hundred yards of broadcloth a day as well as by hand.

In 1814 Jonathan Winslow engaged in the manufacture of flyers of a superior quality for spinning cotton.

Comb-plates for wool-carding machines were offered for sale in 1814 by Daniel Waldo at his store and by Earle & Williams at their shop. At the same time Merrifield & Trowbridge were engaged in making cotton and woolen machinery at the Trowbridgeville privilege.

The prices generally adopted for wool-carding at this time, in Worcester County, were seven cents per pound for common wool, with an addition of three cents when oil was found by the carders; twelve and a half cents per pound for carding half-blooded merino, with the like addition for oil; twenty-five cents per pound for carding full-blooded merino, with the like addition.

An improvement over the ordinary single spindle spinning-wheel is offered by the proprietor, located at Sikes' Tavern, who offers for sale "The Farmer's Spinner," which carries from eight to twelve spindles attached to a single spinning-wheel.

As an indication of the improvements being made in the construction of machinery, attention is called in 1822 to the fact that William Hovey is constructing cylinders for carding-machines entirely of iron, being cast in four parallel pieces.

Stephen R. Tenney is engaged in building wool-carding, matting, shearing and brushing-machines, in the building formerly occupied by Trowbridge & Merrifield as a cotton factory.

In 1822 Ichabod Washburn manufactured machinery for carding and spinning wool at his shop near Sikes' Inn.

January 1, 1823, Mr. Washburn took into partnership Benjamin Goddard (2d), and continued in the same business, to which they added that of carding wool, having purchased the machines lately owned by Mr. Calvin Darby.

In June, 1824, Brewster & Fox advertised the best carding-machines and workmen at their establishment, one mile south of Worcester Village,—the South Worcester privilege—carding, six cents; oiling and carding, seven cents.

The machine-shops, so called, at this time were almost exclusively engaged in the manufacture of cotton and woolen machinery.

William B. Fox, who seems at this time to have separated from his former partner, Mr. Brewster, dresses "Handsome wear" at his cloth-dressing factory, one mile south of Worcester, at twenty cents per yard, "common at sixteen cents."

Sarah Hale, widow of Joshua Hale, offered for sale, March 1, 1826, the factory at New Worcester, consisting of the building "occupied for many years past for the purposes of manufacturing cotton and carding custom wool;" but not finding a customer, she had the machines put in good order and resumed business.

Simmons & Wilder carded wool and dressed cloth about two miles south of Worcester Street.

September 13, 1826, William B. Fox moved his wool-carding and cloth-dressing business to the new building erected on the privilege formerly owned by Samuel Flagg, a few rods south of Worcester Village.

The woolen business at this time was in a most depressed condition, and was said to be done at a loss, even with the most prudent management. It was feared that the probable stoppage of the mills would be severely felt in the community. A meeting was held about this time in Boston, and it was decided that it would be advisable to apply to Congress for an increase of duties on imported woolens, or a reduction of the duty upon wool.

The cotton fabrics made in this country at this time were of excellent quality, and the business was in a much better condition than the woolen business.

A meeting was called in Worcester for Friday, December 1, 1826, at "Stockwell's," to consider the depressed state of the woolen manufactures. At that meeting a memorial to Congress was prepared, signed by Emory Washburn, James Woolcott and Major John Brown.

One of the most valuable contributions to the woolen machinery of the world was the endless rolling, or American card, invented in 1826, by John Goulding, a native of Massachusetts, and for many years a mechanic at Worcester. Previous to the development of this machine the rolls, or rolling issuing from the carding-machine, were limited to the breadth of the card, and the ends of the separate rolls had to be spliced together by hand process, by a machine called a "billy." Goulding dispensed with the "billy," and, by an ingenious combination of devices, obtained an endless roll, and so perfected his machinery that he could use it successfully from the moment the rolling left the dull end of the first picker until it was converted into yarn fit to be manufactured into cloth. This device has been styled the most important advance in the card-wool industry of that early period.[1]

Some knowledge of the equipment of a woolen-factory at this time may be had from a notice of a sale in June, 1827, at the woolen-factory then lately occupied by A. & D. Aldrich, and about one mile south

[1] *Boston Advertiser*, November 3, 1888

of New Worcester, at which were to be offered for sale ten satinet-looms, one double carding-machine, one billy, one shearing-machine, one roping-machine, one press, one copper-kettle, one potash-kettle, press-plates.

In February, 1828, William Hovey stated that he is about to stop his manufacture of satinet shearing-machines, but will continue to make broad and cassimere shearing-machines with vibrating or revolving-shears, and also metallic grinding-machines for keeping the machines in order.

In March, 1830, it was proposed to erect in Worcester a patent hemp and flax-machine, and the Worcester Hemp Company offered to furnish seed to the farmers on the following conditions:

The company would furnish seed at the market price for cash, or in payment would take good notes on interest payable in hemp stem at eighteen dollars per ton, gross weight, when the crop was harvested and delivered at the machine, or would furnish the seed and sow on shares. The company offered to pay eighteen dollars per ton gross weight for good hemp stem delivered at the machine cut, or fifteen dollars without.

In March, 1831, Lewis Thayer and George Willey commenced the manufacture of loom-pickers at New Worcester. Lewis Thayer "carded wool at three and a half cents per pound and waited one year for his pay."

In August, 1831, Washburn & Goddard sold their business of manufacturing woolen machinery to March, Hobart & Company, composed of Andrew March, George Hobart, Henry Goulding and B. F. Smith. This firm was dissolved in 1832, and was succeeded by Hobart, Goulding & Company, who dissolved March 25, 1832. They manufactured pickers, carding-machines, condensers, jacks, etc., also comb-plates, and were succeeded by Goulding & Smith

February 21, 1836, Goulding & Smith dissolved, D. T. Brigham having retired from the firm in 1834, and Henry Goulding continued the business alone. A co-partnership was formed, April, 1837, under the title of Henry Goulding & Company, consisting of Henry Goulding, John Gates, 2d, and Luke Witherby. They were burned out in August, 1838; the building, which was of brick, was valued at three thousand five hundred dollars, and was owned by Frederick W. Paine; the tools and machinery, valued at eight thousand dollars, were destroyed. This concern built at that time about sixty thousand dollars' worth annually of woolen machinery.

Nov. 15, 1841, Goulding & Davis, who had succeeded, dissolved, and Henry Goulding continued. April 1, 1851, Willard, Williams & Company, bought out Henry Goulding; the firm was composed of Fitzroy Willard, Warren Williams, N. A. Lombard, Charles A. Whittemore and H. W. Conklin; this firm was succeeded April 2, 1855, by F. Willard & Company, composed of Fitzroy Willard, Charles Whittemore, N. A. Lombard and H. W. Conklin. This firm was succeeded April 1, 1861, by Bickford & Lombard, who were succeeded by N. A. Lombard, the present proprietor, who has been connected with the business since 1851.

From 1823 until the present time this business has been confined to the manufacture of woolen machinery of different kinds, and at present includes carding and spinning machinery, spinning jacks, pickers, dusters, willowers, etc.

The firm of Phelps & Bickford was composed of Horatio Phelps and William M. Bickford; W. M. Bickford succeeded William Stowell, August 31, 1831, and built woolen machinery, condensing, picking, napping and brushing-machines, also spinning jacks, at the Stowell shop in New Worcester; he was succeeded by Abel Kimball, who continued the business at the same place.

Horatio Phelps manufactured looms of all kinds in the shop formerly occupied by William Howard, at South Worcester, from whom Mr. Phelps had purchased the right to make his patent broad looms. Phelps & Bickford continued to manufacture here, after the formation of their copartnership, all kinds of woolen looms. In October, 1834, they removed from South Worcester to Court Mills, then a new building erected by Stephen Salisbury for the accommodation of parties desiring to lease factory room. Phelps & Bickford afterwards occupied part of the wire factory in Grove Street. Later, Mr. Bickford continued the business alone, and in 1859 he employed twenty-three hands in building looms in the west wing of the Grove Street mill. December 28, 1860, he moved to Merrifield's building, in Exchange Street, where he was prepared to build all kinds of Crompton looms and other fancy looms, broad and narrow; also walking, dressing and spooling machinery, with steam cylinders or pipes for drying; also all kinds of machinery and tools for making wire.

August 17, 1831, John Simmons & Co. announced that they had formed connection in business, and will supply at their new shop in New Worcester the following machinery: Broad and narrow shearing machines, pressing-machines, napping-machines. This copartnership was composed of John Simmons, Abel Kimball and Albert Curtis, and was dissolved February 21, 1832. Mr. Curtis in 1831 took a lease of Lewis Thayer, the then owner of a part of the water privilege which was originally owned by Joshua Hale. Here he erected a machine shop. The old Hale building was a woolen factory, two stories and a basement, and stood where the middle building of the Curtis & Marble factories now is.

Albert Curtis was born in Worcester, 1807. At the age of seventeen he was apprenticed to White & Boyden, who manufactured woolen machinery at South Worcester, near the present location of the carpet-mills. After learning his trade he worked

here for three years as a journeyman, at one dollar and twenty-five cents per day. In December, 1829, he went to Pittsburgh, but returned in January, 1831, and again entered the employment of White & Boyden. While learning his trade he became acquainted with his fellow-workmen, Kimball and Simmons, and they conceived the idea of going to New Worcester and starting for themselves. The firm of John Simmons & Co. was succeeded by Simmons & Curtis, who continued to make shearing and other machinery. In 1833 Mr. Curtis purchased Mr. Simmons' interest, and continued alone until 1834, when Mr. William Henshaw became a partner and so continued until 1839, the firm-name being Curtis & Henshaw. They had not room enough at New Worcester for their business, and for a time leased room of Ichabod Washburn, in the wire-mill in Grove Street. This copartnership was dissolved January 8, 1839.

In 1835 Capron & Parkhurst occupied the old Hale building, which was owned by Clarendon Wheelock.

About 1840 Mr. Curtis purchased of him the Ramshorn water privilege, building and satinet machinery, consisting of two full sets. He had previously bought the Lewis Thayer water privilege, where the old dam stood on Tatnuck Brook, to run his machine-shop. Mr. Curtis leased the old building to John Metcalf and William C. Barber, who ran it until 1842, when it was burned, together with the machine-shop of Mr. Curtis, which was a wooden building with a basement. The original dam on the privilege stood one hundred feet from the bridge toward the location of the present dam, and was about sixty feet long and four feet high.

After the fire of 1842, Mr. Curtis immediately rebuilt the machine shop (52 x 30 feet), three stories high. In 1842 he built a factory on the site of the old Hale mill, a portion of which he leased to Sumner Pratt, to make cotton sewing thread. Mr. Curtis afterwards had an equal interest with Mr. Pratt, and bought him out in 1844. The basement of the building was rented to L. & A. G. Coes, who manufactured wrenches. While Mr. Sumner Pratt was here in the thread business, Mr. L. J. Knowles and a Mr. Hapgood purchased his product and spooled it in another room of the same building, and put it on the market.

After Mr. Curtis bought out Mr. Pratt, he put in looms for making cotton sheetings. The mill was continued as a cotton-mill for several years, when it was converted into a satinet-mill. In 1845 the South Mill was built and used for the manufacture of cotton sheetings and drillings.

In 1870 the South Mill was changed to woolen goods, blankets, shawls and dress goods.

At the north end of Curtis bridge was the old wheelwright shop of E. Graves, now used as a dwelling-house. Mr. Curtis bought out Graves in 1837, and continued the wheelwright business until about 1840.

In 1852 Mr. Curtis bought the Trowbridgeville factory and commenced here the manufacture of cotton sheetings. In 1860 the mill was burned and partially rebuilt and filled with machinery for making woolen goods.

Mr. Curtis changed the 1845 mill to woolen goods in 1871, and has since put in additional machinery for the manufacture of horse blankets.

The mill built in 1842 was changed to satinets in 1857. In 1862 Mr. Curtis took Edwin T. Marble into partnership in his business for manufacturing woolen machinery for finishing woolen, silk and cotton goods, and that partnership has continued to the present time.

This company makes a specialty of shearing machinery, the improvements in which have been greater than in any other machinery used in the manufacture of woolen goods. Mr. Curtis built the first machines for shearing or trimming cotton cloth built in this country; they were used to remove the fuzz from cotton cloth. In old times this was accomplished by singeing or burning.

A shearing-machine made in France was sent from Pawtucket to Mr. Curtis to be repaired. Mr. Curtis examined it and thought it could be improved. He began building the machines then and has continued ever since. Up to that time the French machines had been used in this country. They had one set of shears; the Curtis machine now has from two to five sets. One machine made at the present day will do as much as twelve did in 1830.

December 10, 1833, William H. Howard and Silas Dinsmore made cotton and woolen machinery at their machine shop near the Court-House, and continued in business until September 30, 1834, when they dissolved. In November, 1834, Silas Dinsmore commenced the manufacture of power-looms at the same place, and April 13, 1835, formed a co-partnership with Fitzroy Willard, continuing in the same business. In 1838 Fitzroy Willard was located at Court Mills, where he manufactured broad power, satinet and cassimere looms, and in 1840 Silas Dinsmore manufactured reeds at Court Mills.

The card-clothing industry has been a most important one, and was naturally among the earliest in which the colonists engaged, for the reason that it is essential to the manufacture of textile fabrics. The use to which carding is put is to separate the fibres of the material being worked, and to lay them parallel. The process consists in the reciprocal motion of two surfaces covered with short pointed teeth, between which the stock is placed. Formerly this was done by hand, and was conducted in the household.

"It is probable that either cards proper, or tools closely resembling them, were used as far back as the dawn of civilization, when the art of the manufacture of textiles was in its very infancy. To within a comparatively recent period the processes were very rude, depending mainly on hand labor, and thus the cards employed differed somewhat in their shape from those used at the present day.

"To produce them, a sheet of leather was taken about eighteen or twenty inches by about four inches in width. This was ruled by lines into cross sections as a guide for the workman, who used a pricker with two blades, piercing two holes at a time at the point where the lines intersected until the whole sheet was pierced. This accomplished, the wire was taken, each pin or shaft being separately bent into a staple by hand. The prongs of the staples formed the card teeth, which were inserted also by hand, one staple at a time, into the perforated leather sheet above described.

"The sheet, with its wire teeth, was now nailed upon a board, and called a card. With this appliance, or rather with a pair of them, the operator carded. He placed tufts of cotton, wool or other fibre between them, and drew the one over the other for several strokes until both were equally filled, and then, by a reverse stroke, he cleaned out the fibre in the form of a roll, called a carding, which was used by the spinsters for making their yarn."

Tacks were first used in making hand-cards, and they were for a time manufactured in this country by cutting them out of sheet-iron with a pair of shears. The tack was held in a vise and headed by a single blow. About six hundred and fifty tacks were required for nailing each dozen pairs of hand-cards to the boards on which they were used. All the tacks used for this purpose for many years were made by hand in the manner described above, until Thomas Blanchard, of Sutton, invented an automatic machine for making the tacks from strips of sheet-iron.

Daniel Denny, whose card-factory has been noticed, probably followed the practice of giving the teeth out to women and children, who would set them in the leather at their homes.

Card-setting by hand was done as late as 1828. Earle & Chase, whose store was at the corner of Thomas and Main Streets, state in August, 1826, that persons who wish for cards to be set can be accommodated at their store. In 1829 the average price paid for setting cards by hand was forty-two cents per square foot. A good setter would put in about twenty thousand teeth in a day. The best machines to-day will set three hundred teeth per minute, at an average cost of five cents per square foot. Wages paid card-setters in 1829, $1.33 per day; at the present time, $2.50 to $4.50 per day. The cost of setting cards is now something less than one-eighth the amount paid sixty years ago, and the wages paid average three times as large.

Amos Whittemore, of Cambridge, had patented a card-setting machine in 1797, but it could not be used by others, and the cards made by hand at Leicester were of better quality.

In 1785 the manufacture of cards was begun in Leicester, and to this industry the growth and prosperity of the town is largely indebted. In 1789 Pliny Earle, who had manufactured hard-cards since 1786, made for Almy & Brown, of Providence, R. I., the first machine card clothing in America, as appears from the following interesting letter:

PROVIDENCE, 11th M. 4th, 1789.

RESPECTED FRIEND,

PLINY EARL.—We having pretty much concluded to alter and to cover our Carding Machine, and Joseph Congdon informing us that he expected to go to Leicester soon, we thought we would inclose & send thee the Number & diameter of our Cylinders and propose thy covering them with Cards. We have confered with our Card Makers in Town about doing the Jobb, who appear desirous to do it, and are willing to take their pay, all excepting the cost of the wire in our way, but, it being our object to have it well done, and thinking we could rely upon thy performance, have prefered thy doing it.

We have also had it in contemplation to write to Boston, but, being desirous of having it done soon, and that being likely to protract the time of having it done, have waved that also.

We are not desirous of beating thee down in thy price, or that thou should do it below what thou could reasonable afford, but we have thought, considering thou hast thy machinery now prepared, which was not when thou did that for the company at Worcester, that if we gave thee the same for covering ours as thou had for theirs, tho' a little larger, it would be equivalent to what thou charged them, considering the preparations aforesaid, which the first employers, or rather those on whose account it is especially made, in all such cases must expect to pay, as we have had abundant experience. If that price will answer, we should be glad thou would take the pains to go and view the machine at Worcester, and if there can be any improvement made upon the manner of covering, that, should like thou would make it, either in the Length of the Teeth, or in any other particular. Stowel, who superintends the business there, will chearfully give thee any information respecting the working of theirs, no doubt, upon thy own account and upon ours also, as we are upon friendly terms with him, having divers times been mutually helpful to each other.

We are much in want of ours being done, and should be glad to have it soon; propose, therefore, if thou undertakes the business, that thou would set a time when thou thinks thou could bring the cards down to put on, and we will endeavor to have the machine in readiness to receive them. Inclosed is the dimensions of the Cylinders, that is, their diameters; the second Cylinder in circumference, thou knows, has the cards placed at some distance from each other, in order that the rake may take the rolls of distinctly; ours are about 2½ inches apart.

We are of the opinion that the bind of the teeth ought to be in proportion to the circumference of the Cylinder on which they are placed. We propose having the Cards the same size as those on the Worcester machine, viz.: 16 Inches and all Cotton Cards of equal quality excepting the feeder, and the Cylinder that takes it off of it, and we need not add of the best quality of the number suitable for the machine, of which, we suppose, the machine at Worcester must be considered as a sample. We should be glad to supply thee with any kind of live Stock, if thou should want, at Cost price, or any kind of produce, cloths included, for the whole or part of the amount, if not, we will pay thee the cash. We think that in four weeks from this time we shall be glad of the Cards. A line from thee by Joseph respecting what we may depend on will be agreeable, as we mean to prosecute the accomplishment of the business as fast as may be.

From thy Friend, ALMY & BROWN

P. S.—The diameters of our Cylinders are here subjoined

The great Cylinder	36 Inches
the next	26 "
the next	19½ "
1 ditto	10 "
1 "	6
1 "	3

One of which, the feeder, to be covered with wool Cards.

It has been often said that the first machine card-clothing was made for Samuel Slater in 1790. Mr. Slater landed in New York November 11, 1789. December 2, 1789, he wrote to Almy & Brown, and December 10th received a reply, making an engagement with him. December 14th Pliny Earle set out for

Providence to put cards on Almy & Brown's machine. There is no doubt that Mr. Slater had much to do with perfecting the carding-engine and making it a success after he went into the employ of Almy & Brown.

(I am indebted to Mr. Thomas A. Dickinson, of the Worcester Society of Antiquity, for this information and copy of above letter.)

The leather first used in making machine-cards was calfskin, and then cowhide tanned for the purpose. Sheepskin was generally used for hand cards.

In 1791 Mr. Earle's brothers—Jonah and Silas—became associated in business with Pliny, and in 1806 Silas commenced to manufacture on his own account. At his death his son, Timothy, sold his father's machinery to his cousin, Timothy K. Earle, and Reuben Randall. Mr. Randall's interest, after some transfers, came into the hands of Edward Earle.

Timothy Keese Earle, founder of the T. K. Earle Manufacturing Company, was born in Leicester in 1823. In December, 1843, Timothy K. Earle & Co., consisting of Timothy and his brother, Edward Earle, moved from Leicester to Worcester, and occupied room over Pratt & Earle's iron store, in Washington Square, where they continued the manufacture of all kinds of machine-cards of the best quality. Their machines were built by William B. Earle, between 1843 and 1849.

In 1857 T. K. Earle & Co. built the factory now occupied by their successors for the manufacture of card-clothing cotton, gin-clothing and belting. This has always been the largest card-clothing factory in America.

Edward Earle retired from the business in 1869, and was succeeded by his brother Thomas, who died in 1871. In 1872 Mr. Edwin Brown became a partner, and subsequently, in 1880, the agent and treasurer of the T. K. Earle Manufacturing Company, of which Mr. T. K. Earle was the president.

The T. K. Earle Manufacturing Company own a number of patents on their improvements in the method of producing card-clothing. Pliny Earle made one kind of card-clothing, viz.: iron wire teeth set by hand in leather. The T. K. Earle Manufacturing Company now make all kinds of leather card-clothing, using both hemlock and oak tanned leather, over ten varieties of cloth card-clothing, and use eighteen or more sizes of soft steel wire, eleven or more sizes of hardened and tempered steel wire, besides tinned wire and brass wire of various shapes and sizes. They curry their own leather, manufacture card-cloths and rubber-faced card-cloths for themselves and for other card-makers. They have built almost all their card-setting machines in their own machine shop, and are constantly making improvements in the quality and the methods of card-clothing.

The T. K. Earle Manufacturing Company of Worcester, Mass., have manufactured double and single cover cloth for foundation for card-clothing for the past fifteen years, having special and improved machinery for the purpose, and in 1883 they built a factory on their premises for the manufacture of all kinds of card-cloth, including vulcanized rubber facings. With the very best American and English machinery, and the most improved process of vulcanizing rubber for this purpose, they are now prepared to furnish not only their own large card-clothing factory with card-cloths, but have sufficient capacity to make them for all the card-makers in America.

In 1866 Joseph B. and Edward Sargent, sons of Joseph B. Sargent, the manufacturer of card-clothing in Leicester, organized the Sargent Card-Clothing Company, and built a factory in Worcester, with Edward Sargent as manager. April 15, 1879, the business was sold to James Smith & Company, of Philadelphia.

Howard Bros. Manufacturing Company, Washingington Square, manufacture machine card-clothing, machine wire heddles, hand stripping cattle and curry cards. Established in 1868, by C. A. Howard, A. H. Howard and John P. Howard, continued as a co-partnership until 1888, when the company was incorporated as the Howard Bros. Manufacturing Company, with a capital of forty-five thousand dollars.

They started with four hands, and now employ twenty-two, and occupy ten thousand square feet of flooring. They have a lumber-mill at Keyes, N. H., where they make the backs of their cards. Their machinery is all of their own construction, and much of it special machinery of their own design, notably the card-setting machines, employed for setting teeth, in the cards of which there are from forty thousand to eighty thousand in each square foot of card-clothing. One feature of this business is the manufacture of diamond-pointed card-clothing and hand stripping cattle and curry cards of every description in wood and leather for cotton, wool and flax. Their trade extends throughout the United States and Canada.

Charles F. Kent started the business of manufacturing card-clothing in January, 1880.

There appears to have been a number of small manufacturers of cards in Worcester at different times. Daniel Denny and Earle & Chase have already been mentioned. In 1834, William B. Earle had room in Howard & Dinsmore's shop, near the Court-House, for the manufacture of cards.

In 1848, William E. Eames, 43 Front Street, manufactured cards; he was succeeded by Earle Warner.

In 1849, N. Ainsworth occupied the third story of Goddard & Rice's shop in the manufacture of card-setting machinery. The business was purchased by F. G. Ruggles in 1851.

David McFarland at this time manufactured card-setting machinery, and made the best machines then made in the country. All the machines now running

in the Sargent Card-Clothing Company factory, excepting a few English machines, are the McFarland pattern.[1]

Looms.—"Weaving is the art by which threads or yarns of any substance are interlaced so as to form a continuous web. It is perhaps the most ancient of the manufacturing arts, for clothing was always a first necessity of mankind.

"The simplest form of weaving is that employed in making the mats of uncivilized nations; these consist of single untwisted fibres, usually vegetable, arranged side by side to the width required, and of the length of the fibres themselves, which are tied at each end to the stick which is so fixed as to keep the fibres straight and on the same plane; then the weaver lifts up every other of these longitudinal threads, and passes under it a transverse one, which he first attaches by tying or twisting to the outermost fibre of the side he commences with; and afterward, in the same way, to that on the other side, when it is passed through the whole series. The accession to the art of spinning threads of any length enables more advanced nations to give great length to the warp, or series of threads which are first arranged and to pass the weft, or transverse thread, backward and forward by means of a shuttle without the necessity of fixing at the sides. That kind of weaving which consists of passing the weft alternately over and under each thread of the warp is called plain weaving; but if the weaver takes up first one and then two threads alternately of the warp series, and passes the weft under them for the first shoot of his shuttle, and raised those which were left down before for the second shoot, he produces a cloth with a very different appearance, called twill.

"There are few arts which require more patience than weaving; as many as from one to two thousand threads often constitute the warp, and these threads may be so varied in quality as to produce many varieties of fabric. From that cause alone there are almost infinite variations; many may be produced by the order in which the threads are lifted for the passage of the weft; that of itself can also be varied as much or more in its quality and other circumstances, so that the inventive genius of the weaver finds incessant opportunities for its display, and nice arithmetical calculations are required in estimating and allotting the numerous threads to the endless variety of patterns which are constantly passing through the loom."[2]

The first practical power-loom was devised in 1785 by Dr. Edmund Cartwright, of Derbyshire, England, a minister of the Gospel, and ignorant of mechanics. He is said to have had his attention turned to the subject by the remark that when Arkwright's patents for spinning yarn by power should have expired, so many persons would go into the spinning business that no hands would be found to weave the cotton. He spent thirty thousand pounds in endeavoring to perfect his loom, and in 1808 received a grant from Parliament of ten thousand pounds for his services. Steam-power was applied to his looms in 1807.

Improvements were rapidly made upon the Cartwright loom by other inventors, and it was soon brought into general use for both cotton and woolen goods.

Ichabod Washburn speaks in his Autobiography of seeing a power-loom in the winter of 1813–14, which was so crude that all the cog-wheels were made of wood, and expresses the opinion that it was probably the first power-loom in the United States. Whether this be true or not, it is certain the power-loom had not, at that time, been long in operation in this country.

In the fall of 1823, Wm. H. Howard and Wm. Hovey were in business together, and after building various kinds of machinery, commenced building broad power looms, and finally settled on the common Scotch looms as the best, and put them in operation at the factory of the Goodell Manufacturing Company, Millbury, at the Pameacha factory in Middletown, Conn., at the Torrington and Litchfield factories, and elsewhere.

This partnership was dissolved, and early in 1825 each manufactured these looms on his own account, William H. Howard building broad power cassimere and kerseymere looms, carding and shearing-machines at his shop, one mile south of the Main Street in Worcester,—South Worcester privilege.

For satisfactory proof of the superiority of his looms, he referred to the Goodell Manufacturing Company in Millbury; to Wolcottville Manufacturing Company, in Torrington, Conn.; and to Zachariah Allen, Providence, R. I.

These looms were sold for one hundred and twenty-five dollars each, delivered at the shop in Worcester, including the expense of putting them in operation.

In 1828 Rice & Miller advertised for sale satinet power-looms, and in 1830 Wheelock & Prentice took the shop theretofore occupied by William H. Howard, at South Worcester, and purchased of him the right to build his improved looms, upon which he had a patent for an improvement in the lay motion, consisting of an irregular slot in the sword of the lay through which it was moved. There are many looms now in operation with this movement.

In 1832 Horatio Phelps carried on the loom business at the shop formerly occupied by William H. Howard, having purchased the right to make and sell the Howard Improved Patent Broad-loom.

The business was conducted at the same place in 1833, by Phelps & Bickford, who advertised that they were prepared to build to order all kinds of woolen looms of the most improved plan. In addition to the

[1] Much of the material used in the article on card-clothing is taken from a book called "A Century Old," published by the F. K. Earle Mfg Co., and written by H. G. Kattenhorn and A. C. Gould.

[2] People's Encyclopedia.

business of making the broad satinet cassimere power-looms, they manufactured to order reeds of any description.

Prescott Wheelock was building looms at his shop in New Worcester in 1833, of any description that the public might want, and in 1835 Silas Dinsmore and Fitzroy Willard formed a copartnership to manufacture power-looms; they dissolved in November, 1835, Fitzroy Willard continuing the busine-s at the same place in Court Mills, where he manufactured broad power satinet and cassimere looms. He built fifty broad power looms in Worcester for W. & D. D. Farnum, and Mr. Samuel Porter helped set them up in the mill at Blackstone, in 1835. Most of the machinery for that mill was built in Worcester. Henry Goulding constructed the carding and spinning-machines.

All the looms which have been spoken of up to this time were plain looms, so-called, the fancy loom being an invention of later date. The plain loom is one in which a few harnesses, operated by cams, are used. The goods woven on this loom are like cotton or twilled fabrics.

The modern fancy loom varies in range from two to forty harnesses. The movement of these harnesses is controlled by a pattern-chain, made up to correspond with the different make of goods, and for different colors of filling in the goods, drop-boxes, or movable boxes are required, which are also controlled by chain, according to the pre-determined pattern. With these boxes from one to seven colors can be used.

In the trade at the present time the cam-loom, with a single box, whether of two or eight harness capacity, is usually spoken of as a plain loom, and any loom whose mechanism is controlled by chain made up according to a pre-determined pattern, is usually spoken of as a fancy loom.

Up to 1836 the harnesses of all power-looms were operated by cams; consequently the changes of weave of which the looms were capable were very limited, and goods for which an intricate figure or design was required were necessarily woven, as formerly, in a hand-loom.

In 1836 William Crompton, a native of Lancashire, England, a practical weaver both by hand and power, came to Taunton, Mass., and entered the service of Messrs. Crocker & Richmond.

While in the employ of that firm Mr. Crompton invented a loom to weave a certain pattern of goods which the looms in the mill could not weave, for which a patent was issued to him in 1837, and the loom was introduced into the manufacture of cotton goods. This loom was the first power-loom invented in which the figure or pattern desired to be woven could be made up in a small chain, and when placed upon the loom would control suitable mechanism to move the harnesses to weave the proper figure. Mr. Crompton went to England and procured a patent for his loom in that country, and in 1839 he returned to the United States, and in 1840 introduced his invention into the Middlesex Mills, in Lowell, Mass. Up to that time no fancy woolens had been woven by power in this country or in Europe, except those woven on hand-looms.

In a letter written in 1877 to the late George Crompton, Esq., by Mr. James Cook, agent of the Middlesex Mills in 1840, the following interesting statement is made:

> The writer, now in his eighty-third year, in looking over a lot of old samples, came across a piece of fancy woven cloth, the very first woven in this country by power, and the idea crossed his mind that it might be interesting to you to learn the beginning of this great revolution in the fabric now in use very generally in this country to the extinction of the plain fabrics formerly used to a great extent.
>
> Your father came to the Middlesex Mills in this city from Taunton, and represented to the writer and Mr. Edward Winslow, now deceased, a machinist in the employ of the Middlesex Company, that he had a loom at Taunton for weaving fancy cottons which he thought might be applied to woolen fabrics. The cotton loom was sent for by the Middlesex Company. Mr. Winslow and myself altered one cassimere loom with the assistance of your father, who was good mechanic, by putting on Crompton's patent. The experiment was an entire success; the alteration was extended very soon to all the cassimere looms and then to the broad looms, so that the whole of the weaving power of the mills was in that direction.

Mr. Samuel Davis states that soon after this, happening to be in Boston, he accidentally met Mr. Crompton at an hotel there, who told him about his loom. Mr. Davis was then building carding and spinning-machines in the old Court Mills, and Mr. Crompton stated to him that he wished to get some one to build his loom; that he had been to Lowell and Lawrence; also to Dedham, but thought that he should close the contract at Lowell. Mr. Davis said he was not building looms, but that Worcester would be a good place to have the looms built, and that Phelps & Bickford would be good parties to undertake their manufacture.

Mr. Crompton came to Worcester and was introduced to Phelps & Bickford, who were then building plain looms. Phelps & Bickford made an arrangement with Mr. Crompton to build his looms upon a royalty, and continued doing so till the expiration of the patent.

In February, 1844, the mill at Northville, owned by Ichabod Washburn, F. W. Paine, G. A. Trumbull, and occupied by William Crompton, was totally destroyed by fire.

In 1848 William Crompton lived in Millbury, where he was engaged in the manufacture of woolen and cotton goods, and where he also had a machine-shop. April 12, 1848, he advertised to sell various kinds of tools used by him in the manufacture of machinery, as he had determined to confine himself to the manufacture of cotton and woolen goods.

Mr. Crompton later removed to Connecticut, where his son, George, worked in Colt's factory. The Crompton patent, meantime, had expired; but it was renewed for seven years, and George Crompton came to Worcester, and associated himself with

Merrill E. Furbush for the manufacture of looms, first locating in Merrifield's building, where they remained till the fire of 1854.

After occupying for a short time quarters in the wire-mill in Grove Street, they hired the Red Mill, near the foot of Green Street, employing about fifty hands in the manufacture of the Crompton loom.

At this time William M. Bickford, the successor of Phelps & Bickford, employed twenty-three hands in the west wing of the Grove Street mill in building looms.

August 1, 1859, Furbush & Crompton dissolved. Mr. Crompton continued the business, buying the Red Mill property, and in 1860 erected a new building, which was a substantial brick structure, one hundred and ten feet long by fifty feet deep, three stories high, besides the attic, exclusive of an ell for an engine-house.

Mr. Crompton at that time employed sixty hands, which number he expected to increase to eighty as soon as buildings could be erected.

The successive improvements in the Crompton loom can best be given by a quotation from an interesting pamphlet on that subject, published by the Crompton Loom Works in 1881: "Furbush & Crompton made narrow looms from 1851 to 1857, when they brought out a fast-operating, Broad fancy loom, with improvements in box-motion. Broad looms, up to this period, operated at about 45 picks; the new 1857 Broad looms, with twenty-four harnesses and three boxes at each end, reached a speed of 85 picks per minute. This was a great stride in production; no advance has been so great since then. The narrow fancy cassimere loom, with three boxes at one end, up to this time had not obtained the speed of 85 picks per minute; but with important improvements in the reverse motion, the simplification of devices for operating the lays by means of the ordinary cranks, the use of the ordinary narrow shuttle and the reduction of the size of the shed made a fast economical Broad power-loom of 85 picks a possibility. One weaver could attend one Broad loom as readily as one narrow; therefore 'broads' at once came into favor and use, and the comparative exclusion of narrow looms was foreseen.

"Furbush & Crompton built looms until 1859, when the partnership was dissolved. The patents granted to and owned by the firm were in part for improvements in double reverse motion, E. W. Brown's invention, of which they were the sole owners; said patents were by mutual agreement territorially divided—the New England States and the State of New York to Crompton, and the remainder of the country to Furbush, and by said agreement Furbush was debarred from making looms of any kind whatever in Crompton's territory."

In December, 1860, William M. Bickford moved his factory to Exchange Street, in Merrifield's building, where he was prepared to build all kinds of Crompton looms and other fancy looms, broad and narrow. This led to a lawsuit which resulted in Bickford's being found to be an infringer of the Crompton patents. On his death, in 1863, the business went out of existence, the patterns being sold to the Crompton Loom Works. Various improvements, many of them patented, have been made from time to time, Mr. Crompton having taken out over one hundred patents in the United States, besides a large number in foreign countries. A number of patents have also been taken out by Mr. Horace Wyman, superintendent for many years of the Crompton Loom Works.

The Crompton Loom Works have thus grown until it is one of the largest manufacturing establishments in Worcester.

Mr. George Crompton died 1886, and the business was incorporated January, 1888, with the following officers: M. C. Crompton, president; Horace Wyman, vice-president and manager; Justin A. Ware secretary and treasurer.

Mr. L. J. Knowles was born in Hardwick, July 2, 1819, and was, in 1836, clerk in a store in Shrewsbury.

In June, 1842, we find the following notice:

"We were shown some miniatures taken by Mr. Knowles at his room in Brinley Row, which we think for beauty, boldness and distinctness exceed anything we have seen."

In February, 1843, L. J. Knowles & Co., in connection with their daguerreotype business, advertise to do electro-gilding and silver-plating.

In 1844 Sumner Pratt leased a portion of one of Mr. Curtis' buildings, at New Worcester, for the manufacture of cotton sewing-thread. Mr. Knowles and a Mr. Hapgood had quarters in the same building, and purchased thread of Mr. Pratt, which they spooled and put on the market.

In 1847 Mr. Knowles commenced the manufacture of cotton warp at Spencer, and in 1849 removed to Warren. During the years 1855 to 1858 he was engaged in the manufacture of satinets in Warren, and made some improvements on the looms he was then running, for two of which he took out patents in 1856—one for a close shed cam-jack for harness motion, and the other for separate picker for each cell in the drop-shuttle box. In 1857 he constructed a drop-box mechanism, for operating drop-boxes by means of cranks set at the opposite extremes of their throw, under the direction of a pattern-chain, or its equivalent. This was the germ of the mechanism of the fancy loom, which has developed by successive stages into the loom as built by the Knowles Loom Works at the present day.

L. J. Knowles and his brother (F. B. Knowles) began the manufacture of looms for sale under the firm-name of L. J. Knowles & Brother, at Warren, Mass., in 1862, and the first looms were made for hoop-skirt tapes, with woven pocket for the wires, and for bindings, tapes, etc. The loom was patented in 1863.

This branch of the business continued till the fall of 1866, when the company removed to Worcester, Mass., occupying Dr. Sargent's Block—Allen's Court. During 1866 the company began the manufacture of cam-looms for satinets, doeskins and other plain goods, and patented a cam harness motion for this loom in November, 1866.

In 1868 they began to make these looms with drop-boxes at each end, so as to use different colors of filling for checks, plaids, etc. In 1871 they began to make the drop-box looms, with chain or fancy harness motion, so as to extend the range of looms according to the requirements of the patterns. Out of this grew the fancy woolen loom of the present style, the first one of which was built in 1872, and sold to the Jamesville Mills, of this city.

In the spring of 1873 the first broad loom of this style was made from new and heavy patterns, and from that time many thousands have been built for the woolen-mills of the country. This loom was patented in 1873. Meantime, the loom business had grown so that in 1876 from seventy-five to one hundred men were employed. The loom was shown at the Centennial Exhibition at Philadelphia, and as a result won for itself a wide reputation. A forty harness loom was made in 1876, and the first one was shown at this exhibition, and a number of them were sold.

In 1879 the business had grown to such proportions that it was necessary to have more room, and the company, in October of that year, moved to what was known as the Junction shop, where the business has continued till the present time, and preparations are being made for the erection of a much larger factory, in order that proper facilities may be secured for the rapidly increasing demands of the business.

In 1884 Mr. L. J. Knowles died very suddenly, in Washington, and the business was conducted by the surviving brother, Mr. F. B. Knowles, until the 1st of January, 1885, when a stock company was formed under the name of the Knowles Loom Works, with Mr. F. B. Knowles as president, which has continued the business under the same general management. In 1885 the company brought out a very heavy loom of thirty harness capacity for weaving worsted goods, which has been very largely introduced. Of this loom they have built and delivered the largest single order for heavy woolen looms ever given in this country, namely—two hundred and four looms for the Riverside and Oswego Mills, of Providence, R. I.

The old hoop-skirt loom has gradually developed into a loom for silk ribbons, suspenders, bindings and all kinds of narrow goods, with great success.

Within a few years the company has perfected and put upon the market looms for weaving flannels, dress-goods, fancy cottons, etc., and large numbers of them have been put into the best mills.

They have also recently brought out various looms designed for gros-grains, satins and the various kinds of silk goods, plain or fancy; also coverings for upholstery work, portières, draperies, etc., for silk velvets, mohairs and silk plushes; and have probably made the widest looms for fly shuttles ever made, having a reed space of two hundred and thirty-six inches.

They have also introduced, within a few years, a power-loom for ingrain carpets, many of which are now running in the best carpet-mills in the country, and are giving perfect satisfaction.

All the Knowles looms are built on the open shed principle, which is their distinctive feature.

The value of the Knowles loom has also been recognized in Europe, and elsewhere, where it is being largely introduced by Messrs. Hutchinson, Hollingsworth & Co., of Dobeross, England, who are building them in large numbers and already have several thousands of them in successful operation.

The Gilbert Loom Company, Charles W. Gilbert, proprietor, was established in 1866, and is situated at 186 Union and 33 North Foster Streets, Worcester. They employ about fifty hands, using steam-power from a ninety horse-power engine, and are building looms and machinery as follows:

Looms for the weaving of tapestry, Brussels and velvet carpets, mohair and cotton plushes, fancy woolen (twenty-four harness, four drop boxes) for woolen and worsted goods. Fancy cotton looms, gingham looms, coach lace looms, satinet flannel, blanket, jean and cassimere looms, gunny cloth and pine fibre looms, tape and narrow wire looms for No. 20 and finer wire, cam looms for chairs and car-seats, heavy looms for cotton duck and belting, needle looms for wipers and sugar strainers; and, in addition to looms, they also build yarn-printing drums and belting frames for tapestry and velvet carpets, cop winders for jute, wool, linens and cotton, yarn spoolers, mill shafting, gear cutters and harness frames; they are also designers and builders of looms for new and special purposes.

In 1854 Rodney A. N. Johnson & Co., composed of Mr. Johnson and Daniel Tainter, manufactured spinning machinery for wool carding machines, pickers, twisters, spools, bobbins, boring machines, card clothing, etc., at Merrifield's Steam Mill.

In 1859 Fox & Rice manufactured fancy cassimeres on the stream at the junction of Green and Water Streets, employing two hundred hands and manufacturing fifty thousand yards of cloth monthly. Daniel Tainter, at the same time, employed thirty hands in Union Street in the manufacture of wool-carding machines and jacks.

The business now conducted by the Cleveland Machine Works Company, the well-known builders of woolen machinery, located at 54 Jackson Street, was established in January, 1860, by Mr. E. C. Cleveland, who commenced the manufacture of woolen machinery in Central Street in what was then known as Armsby's building. He manufactured cloth dryers,

hydro-extractors, cloth-brushing machines, jacks, presses, fulling-mills and wash-mills, and continued in this business until early in 1863, when, in addition to the above-named machines, he built the first set of the well-known Cleveland cards, which are used for converting wool into roving previous to spinning. These cards were sold to Messrs. Howe & Jefferson, of Jeffersonville, and are now running in the mill of the Jefferson Manufacturing Company, and doing good work after twenty-six years of service.

About this time the late John C. Mason and Mr. J. M. Bassett were admitted to the firm. They, after several years, withdrew, and Mr. Cleveland continued the business until his death, which occurred April 28, 1871. Since the building of the first set of cards hundreds of sets, with improvements from time to time, have been built, and are now in successful operation in first-class mills.

Since the death of Mr. Cleveland the firm has been managed by Mr. S. W. Goddard, who has introduced many new machines and many improvements in the machines made previously. They now manufacture about fifty machines for different uses in woolen mills, making a specialty of all kinds of cards for wool, worsted, felt and shoddy; also twisting, roving, spooling, picking, drying and cloth finishing machinery. The product is sold throughout the United States, Canada and Mexico.

In February, 1863, the late Hon. Isaac Davis sold the lower Junction shop, built by Eli Thayer in 1854 for gun work, and used in 1861 for soldiers' barracks with twelve acres of land, to Jordan, Marsh & Co., of Boston, who intended to convert it into a woolen-mill, with sixteen sets of machinery, making it one of the largest woolen-mills in the State. This shop was first known as the South Junction shop; later, as the Pistol Shop Barracks and Adriatic Mills. Jordan & Marsh made extensive improvements. The main building was four hundred feet long, forty feet wide and two stories high. The second floor was devoted to carding and spinning, and was arranged for twelve sets of cards and twenty packs of four thousand eight hundred spindles. The first floor was for finishing and weaving; the weaving all to be done by looms made by George Crompton, of Worcester. The main belt was one hundred and fourteen feet long, and thirty inches wide, double throughout, and made at the shop of Graton & Knight in Front Street. Particular attention was called to this, as showing that the equipment of a woolen factory could be procured in Worcester; the cards, jacks, dryers, dressers, extractors hydraulic presses, etc., were furnished by the Cleveland Company.

This mill is now owned by the Worcester Woolen Company, incorporated in 1881. The building is now five hundred and eighty-two feet long, forty-two wide, two wings—one seventy-two by sixty, the other ninety by fifty-six. The number of the hands, at the beginning two hundred, is now two hundred and thirty. They have thirteen sets of cards, fifty eight broad and two narrow looms, and twenty Bancroft operators. They make fine woolens, cassimeres and suitings, and produce from five thousand to eight thousand yards per week, the annual sales amounting to six hundred thousand dollars. The present proprietors, the Messrs. Legg, came from Rhode Island. March, 1881, James Legg, Jr., became the owner of the mill, and it was run under the name of James Legg, Jr., & Co., until July, 1881, when the present firm, James & John Legg, succeeded.

The Alma Woolen-Mills, in Green Street, employ two hundred hands in the manufacture of fancy cassimeres and suitings, running fifty-nine looms and eight sets of cards with attendant machinery.

The firm of Johnson & Bassett, manufacturers of self-operating mules and jacks, was established in 1870.

In 1868-69 experiments looking towards making the jacks self-operating were going on in several parts of the country, and were being conducted in the shop of Cleveland & Bassett, in Worcester, by Edward Wright.

The failure of Cleveland & Bassett in the fall of 1869 brought Mr. Wright's experiments in their works to an end, but he arranged to go on with Johnson & Co., jack builders, and July 1, 1870, the copartnership was formed between Johnson & Bassett. The first self-operating attachment for jacks of their make was put at work in the mill of John Chase & Sons, at Webster, in 1870, since which time Johnson & Bassett have built up an extensive business in the manufacture and sale of self-operating heads for application to hand-jacks, self-operating jacks complete with heads, and self-operating mules. The business was located in the Merrifield Buildings, 180 Union Street, until October 1, 1886, when it was removed to Mr. Bassett's new building, corner of Foster and Bridge Streets.

The Crompton Carpet Company was organized in 1870 by George Crompton, who, with the superintendent, Horace Wyman, invented and patented a loom for weaving Brussels carpets by power, there being at that time no power loom for that purpose, except the Bigelow loom and two makes of English looms, the right to use which could not be obtained in this country. The manufacture of Brussels carpets, therefore, was confined to the Bigelow Company at Clinton, and the greater part of the carpets used in the United States was imported from England, and a high price was consequently maintained. Mr. Crompton associated with himself in the enterprise Dr. Joseph Sargent, William Cross, Horace Wyman, W. W. Rice, William H. Jourdan and Calvin Foster—George Crompton being president of the company; William Cross, treasurer; Joseph Sargent, Jr., agent, and M. J. Whitall, superintendent. After the death of Mr. Cross, Joseph Sargent, Jr., was elected treasurer.

They commenced operations with sixteen looms of Crompton make. The factory was located in South Worcester and was a two-story building, French roof, 115x60, run by water-power, the amount being estimated at one hundred horse-power. In 1871 a dye-house was added to the mill (which stood near the site of the old White & Boyden mill, burned August, 1863, and referred to previously). This enterprise was the beginning of the general manufacture of Brussels carpets in this country. Other companies were soon formed, the restrictions were removed from the sale of the English-made looms, and, in consequence, the price of carpets rapidly declined from three dollars per yard in 1870 to one dollar per yard in 1879.

The company started with one hundred and fifty thousand dollars capital, and, before their operations ceased, had increased the number of their looms from sixteen to thirty-six, and continued until 1879, when the machinery was sold to W. J. Hogg, Sr., of Philadelphia, and later the building containing the carpet machinery was leased to Mr. Hogg.

The Packachoag Worsted and Yarn-Mill was built and owned by Mr. George Crompton. This mill was near the Crompton Carpet Company, and was managed by Joseph Sargent, Jr. In the yarn-mill they started with twenty-four spinning frames and accompanying machinery; later, Mr. Crompton built another yarn-mill adjoining the first. The first Packachoag Mill was burned in 1884; loss, one hundred and eighty-one thousand two hundred and seventy-five dollars. After the fire Mr. Crompton sold the land and the ruins of the Packachoag Mill in part to Mr. M. J. Whittall and in part to William James Hogg, Jr.

Mr. Whittall, who was superintendent of the Crompton Carpet-Mill from the commencement of business, was from Stourport, England, where he was manager of the Severn Valley Carpet Works of Fawcett & Spurway. In 1879 Mr. Whittall returned to England, and while there purchased eight Crossley Carpet Looms. He brought these to this country, and began to operate them in a building leased of the Wicks Manufacturing Company. In 1882 another story was added, and Mr. Whittall added eight more carpet-looms; but business increasing, more room was needed, and he determined to erect a building for himself; and in 1883 bought of Mr. Crompton a piece of land facing Mr. Crompton's original carpet-mill, and erected a building one hundred and seventy-five by sixty feet, two stories in height. This mill was finished during that year, and the machinery from the Wicks building, together with fourteen new carpet-looms, was put into operation. In 1884 an extension was added, together with twelve looms, making forty-two in all.

It will be recollected that Mr. Whittall had purchased part of the land and all of the buildings that remained of the Packachoag Mill property, and on this spot he erected another carpet-mill, and also repaired the old yarn-mill, engine-house, etc. In this new mill he had seventeen new looms, making fifty-nine carpet-looms in use in his business. He manufactures six-frame and five-frame Wilton and body Brussels carpets, and employs about three hundred and twenty hands.

In 1884 Mr. Hogg built a yarn-mill on part of the land he had purchased of Mr. Crompton, on the site of the first Packachoag Spinning-Mill, and has continued to run it up to the present time. This building was one hundred by sixty feet. The last mill built has seventeen looms, making in both of his mills fifty-three looms, which he runs at the present time, employing about three hundred and twenty hands.

Mr. Whittall is the largest individual manufacturer of Wilton and Brussels carpets in the United States. Mr. W. J. Hogg is the second largest.

The manufacture of thread has been conducted in Worcester for over twenty years. This is a most favorable place for this industry, because of the excellent shipping facilities, and the fact that the Worcester Bleach & Dye Works—one of the best dye-houses in the country—is located here.

Thread was first manufactured in Worcester in 1865. The business was discontinued from 1879 till 1881, since which time it has been a rapidly-growing industry. The Glasgo Thread Company, so called by reason of the fact that this company controls a spinning-mill at Glasgo, Conn., was incorporated in March, 1883, and for a time the business was conducted in Foster Street, in the building of Charles Baker. In 1885 the company removed to Beacon Street, where it is now located. The average daily production, at the present time, is four thousand dozen of two hundred yards.

The process of manufacture is most interesting, and consists in carding cotton until the fibres lie parallel to each other; the loose rolls are then taken to the drawing-machine, which consists of a series of rolls, each set revolving faster than the preceding, which reduces the strand to the required degree of fineness. The strands are repeatedly united and reduced. This process is called "doubling," and ensures a uniform, strong and perfect product.

The united threads, which are called "slivers," are then spun into a single thread on a mule. After being dyed the skeins are subjected to the operation of drying, and are then put upon spools for finishing by saturating with sizing, and then passing over rapidly revolving brushes.

Important improvements have been made in thread machinery since the introduction of its manufacture in this city; the most important is the automatic winder, with which the operator can wind from two to four times as much, and with less exertion, than he could formerly do by hand. The automatic machine is set to wind any number of yards the operator may desire.

The Glasgo Thread Company was the first to in-

troduce fine Sea Island thread upon pound spools. Formerly only the small spools were used, but now almost any size may be found, from two hundred to thirty thousand yards, which has led to a considerable saving to the consumer. The greater part of the thread used by the manufacturing trade is put up on large spools holding from six thousand to thirty thousand yards.

The Ruddy Thread Company, manufacturers of all grades of cotton thread—principally for the manufacturing trade, sewing-machines, corset-works and shoe manufactories, was established in 1887, and is located at 75 Central Street, under the management of Mr. Robert Ruddy.

C. H. Hutchins & Co., 2 Allen Court, established in 1876, manufacture elastic and non-elastic webs for suspenders and stocking-supporters, also spool tapes, used by cotton and woolen manufacturers to tie up their goods. The material used is cotton and rubber, the rubber being woven in process of manufacture. The looms are the Knowles fancy loom, one of which will weave twenty-five hundred yards per day.

The L. D. Thayer Manufacturing Company, in the building formerly occupied by Ethan Allen. Established in 1878, and manufactures tapes, bindings, galloons and webbings, and operates sixty-eight looms.

A. G. Hildreth, in Stevens' Block, manufactures overalls, pants, shirts, butchers' frocks, etc., employs forty-five hands, using sixteen sewing-machines. In 1887 three hundred and twenty-five thousand yards of cloth were cut up, and in 1888 five hundred thousand yards.

The Holland Hosiery Company, established in Hallowell, Me., in 1883, moved to Worcester in 1886, and manufactures seamless half hose.

The Worcester Felting Company, in Foster Street, do a large business in the manufacture of linings, upholstery, saddlery felts, petershams, rubber-boot and shoe linings and trimming felts.

George L. Brownell manufactures improved twisting machinery of his own invention for laying hard and soft twines, lines and cordage.

The Carroll Machine and Spindle Works manufacture machinery for twisting yarns.

Among the smaller manufactures connected with textile fabrics, but none the less important, may be mentioned the improved loom-reeds, manufactured by M. Place & Co., whose business was originally established by Silas Dinsmore in 1810.

William H. Brown, 81 Mechanic Street, manufactures a number of ingenious tools for the use of carders. This business was established in 1855.

In 1876, Mr. B. S. Roy, now located at 75 Beacon Street, began the manufacture of card-grinders, for grinding card-clothing, all his machines being of his own invention. Mr. Roy was formerly superintendent in a cotton-mill, and, recognizing the necessity of a better method for grinding the card-clothing, engaged in his present business. The old method of grinding cards was by spreading emery on a board, which was rubbed back and forth over the ends of the wires, thus sharpening the teeth. This process was called by the English "strapping" or "strickling" the cards.

The next improvement was the construction of a machine, with a cylinder covered with emery, but with no traverse wheel. This method of grinding teeth made them uneven. In Mr. Roy's improvement, the traverse wheel runs with an endless chain back and forth on the cylinder over the teeth of the card with a rotary motion. These machines are sold in this country, South America, Mexico, Canada, England and Ireland.

J. H. Whittle, established in 1880, manufactures tin spindles for mules, spinning-frames, drawing-cans, filling-boxes, condenser-rolls, slasher-cylinders, drying-cans, etc., rubber-rolls for woolen-cards, and immersion-rolls of copper.

CHAPTER IV.

MANUFACTURING AND MECHANICAL INDUSTRIES.

Foundries—Machinists' Tools—Agricultural Implements—Wrenches.

FOUNDRIES.—Mr. William A. Wheeler was one of the oldest iron founders in the State, having begun in 1812; he moved from Hardwick to Brookfield, and from the latter place came to Worcester in 1823 and established a blacksmith's business at the corner of Thomas and Union Streets. Among other pieces of work he made the doors of the Court-House in Worcester. This blacksmith's shop was on the site of the foundry. In 1825 Mr. Wheeler, in company with George T. Rice, H. W. Miller and A. D. Foster, under the name of William A. Wheeler & Co., made all kinds of castings, fire-proof book-cases and doors. To run a fan for his cupola-furnace, Mr. Wheeler had the first steam-engine, or one of the first ever operated in Worcester. In 1826 the business passed under the control of the Worcester & Brookfield Iron Foundry, which had furnaces in both places.

Daniel Heywood & Co. furnished at this time all kinds of castings. The demand appears to have been considerable, for in 1827 Washburn & Goddard received orders for machine castings made at Stafford, Conn.

In 1828 Sumner Smith (Worcester Iron Foundry) put a furnace in blast near the paper-mill of Elijah Burbank, at Quinsigamond, and had for sale every description of iron castings, cast-iron plows, stoves, cauldron kettles, hollow ware, oven frames, Darby's patent wheel boxes. In 1833 the Worcester Iron Foundry removed from Quinsigamond to the first mill privilege north of Main Street, one mile from

the Court-House, on the Worcester road leading to West Boylston.

In 1831 or 1832 Mr. Wheeler returned to Worcester and reorganized his shop, abandoned the steam-engine which he had previously put in, and substituted horse-power, and continued to do a constantly increasing business until the foundry was enlarged, about 1840, when another steam-engine was added and a machine shop attached. The castings were made for the iron-workers and tool-makers in the city, and comprised castings for heavy gearing, besides a variety of other work, including heavy sheet-iron work, fire-proof safes, mill-irons, water-wheel irons, cages, coupling-boxes, plow-castings, patent ovens, ash-holes, boiler-doors and pipe-boxes; factory shafting was also turned.

About the time his machine-shop was started Mr. Wheeler procured an iron planer, to be run by hand. This was the first iron planer in Worcester, or in the State. It would weigh about one hundred and fifty pounds, and was three and one-half feet high. The bed was four feet long and twenty inches wide.

Mr. Wheeler designed the first boring-machine in Worcester, and in 1838 got out patterns for cook-stoves, box-stoves for heating, and manufactured them, and in 1842 invented a furnace for heating buildings with wood or coal.

In 1838 he started the manufacture of brass castings for general use.

When Mr. Wheeler commenced business he made five hundred or six hundred pounds of castings per day, and increased until his daily production was ten tons. He began with three or four men, and in the height of his prosperity employed two hundred.

In 1852 Mr. Wheeler's son (Charles) became interested in the business at Thomas Street, and when William A. Wheeler died, in 1873, it passed into the hands of William F. Wheeler, and finally to the Wheeler Foundry Company, which remained at the old location for a time, and then moved to 138 Mechanic Street, where the business has been located for seventeen years, employing about ninety men, largely in making castings for wire and rolling-mill machinery and for general purposes.

In 1843 the Washington Square Iron and Brass Foundry, built by A. A. Trask, was operated by S. Trask & Co. in the manufacture of cauldron-kettles, stoves, oven-doors, ash-pits, etc., and in 1843 a new foundry was built near the Boston and Worcester Railroad by Henry P. Howe, and was occupied by George Goodnow in the manufacture of iron, copper, brass and composition castings.

In 1847 Oliver K. Earle built a foundry on the corner of Canal and Foundry Streets. He sold out to A. B. Chaffee in 1848, who took Jason Chapin into company the same year. They started in business to supply Howe & Goddard with their brass castings. In 1852 Chapin purchased Chaffee's interest, and in 1853 built a shop in Manchester Street, where he continued until 1859, when he built the shop in Summer Street, where he continued until 1887, when he sold out to Mr. L. H. Wells.

In 1849 Fitch & Jones made castings in iron and brass, and were succeeded in 1850 by E. & D. H. Fitch & Co.

In August, 1850, McFarland & Bisco, of Leicester, started in the malleable iron business, which was continued in 1851 by Wood, McFarland & Co. They occupied the building known as the Arcade, formerly known as "The Old Brewery," near the Western depot. Here, with one air furnace and two small annealing furnaces, they commenced the making of malleable castings for guns, carriages, harness buckles, wrenches and parts of cotton and woolen machinery, previously made of wrought iron. At this time there was but one other malleable iron foundry in the State, which was located at Easton. The process of malleable iron founding is different from that of ordinary casting. The purpose to which the product is applied requires a greater degree of tensile strength and tenacity in the materials and a closer attention to all the details. Instead of placing the coal and pig-iron in the furnace together, the pig-iron is thrown into what is called the air furnace by itself and subjected to an intense heat; it is then drawn out and poured into moulds, in which state the metal is very hard and brittle; it is then packed in an annealing furnace and subjected to strong heat for about nine days and nights, when the furnaces are opened and the pots cooled; the iron is then unpacked and cleaned ready for delivery, when it has both fineness of grain and great toughness.

The old firm of Wood, McFarland & Co. remained in business but a short time; their interest was taken by Warren McFarland, who continued with a silent partner until 1877, when he became the sole owner.

From one air furnace and two annealing furnaces the plant was increased until it had two air furnaces and six annealing furnaces.

In 1880 Mr. George B. Buckingham, who had been connected with Mr. McFarland since 1873, took charge of the works, Mr. McFarland remaining connected with it till his death, in 1884.

In December, 1886, Mr. Buckingham purchased the property of the Worcester Malleable Iron Foundry, that being the second known by this name, which had been run about three years, and has since been run as the Worcester Malleable Iron Works, giving the two plants, now under one management, a capacity of three air furnaces and nine annealing furnaces.

The line of goods now made includes different parts of agricultural implements, guns, pistols, sewing-machines, cotton and woolen machinery, in fact, all parts of machines or tools where strength and lightness are combined. The use of malleable iron and steel castings, which are now made by the above

works, is largely owing to the reasonable price in comparison with forgings, as odd shapes can be more easily produced than by the forge.

The second malleable iron foundry, known as the Worcester Malleable Iron Foundry, was started in Manchester Street, by Waite, Chadsey & Co., in 1852.

In 1857 Oliver K. Earle, who had previously been in the lumber business, was admitted into partnership with Fitch & Jones, who continued business at the Union Street Foundry (present site of Rice, Barton & Fales) and also at the Junction Foundry in Southbridge Street. After Mr. Earle's death, Willard Jones, Wood & Light, Richardson, Merriam & Co. succeeded; it was then taken by Mr. Otis Warren, the present proprietor, who has controlled it for the last fourteen years. The first work done at this foundry was the manufacture of the iron-work for the front of Foster's Block, at the corner of Main and Pearl Streets.

Caleb & J. A. Colvin commenced the foundry business at Danielsonville, Conn., in 1863, where they manufactured stoves and machinery castings. In 1865 Caleb sold his interest to his brother and moved to Worcester, where he bought and built his plant in Gold Street.

The business increasing, J. A. Colvin moved to Worcester, and a new partnership was formed, which continued until 1880, when J. A. Colvin built his present foundry in Jackson Street. His principal work is for the loom companies, and largely for the Knowles Loom Works. He employs about ninety hands.

Since 1880 Mr. Caleb Colvin has more than doubled his capacity for doing work. He employs ninety hands, and has a capacity of three hundred tons per month, almost entirely used in the city, and largely by the makers of woolen machinery, machinists' tools and wood-working machinery.

Heald & Brittan built on Foundry Street about 1866, and made iron castings. They removed from there to Thomas Street Foundry, when the Wheeler Foundry Company moved to Mechanic Street. This foundry afterwards came into the possession of the Holyoke Machine Company.

L. H. Wells and Herbert M. Rice began business January 1, 1867, in North Foster Street. Mr. Wells learned his trade of Jason Chapin, and was subsequently foreman of the late George Crompton's foundry, in Green Street. Mr. Wells purchased Mr. Rice's interest in September, 1869, and in 1877 invented his bronze metal, largely and successfully used for bearings. By the use of chemicals the oxidation of the tin, one of the ingredients, is prevented; the metal is ten per cent. denser than the ordinary bronze, and of a very firm, tough structure. In 1887 Mr. Wells purchased the Chapin Foundry in Summer Street, to which he has removed. Mr. Wells has the largest set of furnaces in the city; his castings are cleaned by power in a large water rumble, a hollow cylinder, which makes ninety revolutions per minute, and emery wheels are used for smoothing the castings.

The process of casting is simple, and consists of melting the metal in crucibles, which are made of plumbago, and then turning the molten metal into moulds. When taken out they are cleaned and finished.

Prespey Pero, located in Hermon Street, manufactures machinery and tool castings, and makes a specialty of light castings; was established in 1877. His business has grown from employing three or four men until he now employs forty-five.

The Star Foundry was established in 1880 by George Crompton, and started with forty men. Double that number are now employed on all kinds of work, including steam-engines, machinists' tools and castings for building purposes, although the principal product is loom castings for the Crompton Loom Works.

Luther Shaw & Son do a business in brass casting, and manufacture Babbitt metal and solder, also all kinds of brass composition, zinc, lead and white metal castings. They also make gong-bells, faucets and copper castings. Their product is sold throughout New England, and some of it in New York State, but the bulk of it is used in this city and county. The metals used are principally copper, tin and antimony.

Arnold & Pierce, at the Hammond Street Foundry, established in 1882, began with six men, and now employ twenty-two. They manufacture castings for the makers of machinists' tools.

The firm of A. Kabley & Co., composed of A. Kabley, Alonzo Whitcomb and F. E. Reed, located at 57 Gold Street, started with fifteen men, and now employ forty. They supply all the castings for the machinists' tools of F. E. Reed and Alonzo Whitcomb & Co., besides some general work.

Machinists' Tools. — The manufacture of machinists' tools has, for many years, had a most prominent place among the industries of Worcester. To Samuel Flagg, or, as he was more familiarly known, "Uncle Sammy Flagg," belongs the distinction of having first engaged in this business in Worcester, whither he came, from West Boylston, in 1839, to secure better facilities and to save cartage of castings which he used in his machine-shop in West Boylston, where he built tools and cotton machinery from patterns made by William A. Wheeler. He made a turning lathe, which was the first one Mr. Wheeler had when he started his machine-shop. The ways and frame of his machine were of wood, the head and tail-box of iron.

Mr. Flagg hired room and power of Samuel Davis, the lessee of Court Mills, and there made hand and engine lathes. He had no planer when he commenced, and at this time the planing of iron was

looked upon as a remarkable accomplishment. The work was done by hand-chipping and filing, which was of necessity tedious and unsatisfactory.

The old Court Mills, located on Mill Brook, at the junction of Lincoln Square and what is now Union Street, was the cradle of the machinists' tools industry in Worcester, as it was of many others.

Mr. Flagg started with eight or ten men, and every one thought that he was visionary to expect to keep them occupied in building machinists' tools. He was the first man in Worcester to use a planer in this business. He commenced in Court Mills. Ruggles, Nourse & Mason, and Thomas Daniels, the inventor of the Daniels planer, were also tenants. Deacon Richard Ball was at this time Mr. Daniels' foreman.

In 1845 Thomson, Skinner & Co. succeeded to Mr. Flagg's business. They moved to Merrifield's building, and, shortly before the fire of 1854, were absorbed by the New Haven Manufacturing Company, and removed from the city. Mr. Flagg continued without a competitor until Pierson Cowie started in the old Red Mill, the present location of the Crompton Loom Works. From there he removed to the then new building of Howe & Goddard, now Rice, Barton & Fales, in Foster Street, and thence into the building where W. T. Merrifield's engine is now located.

In 1845 or 1846, Cowie made six iron-planing machines which were driven with a common log chain passing over a drum at each end of the machine. This arrangement was, in a few years, superseded by a rack and gears.

He was succeeded in 1845 or 1846 by Woodburn, Light & Co., who, in 1851, moved to Estabrook's new building at the Junction, built by Charles Wood and Col. James Estabrook. Later the firm became Wood, Light & Co., and, in 1870, built the shop now occupied by Meiver Brothers, where they at one time did a very flourishing business, and had the best equipped shop in New England, employing one hundred and seventy-five men. They introduced greatly improved methods for turning shafting, increasing the amount from forty or fifty feet per day to three hundred feet. They also invented and manufactured bolt-cutting machines, the best then known.

The building of railroads created an increased demand for machinists' tools, and in 1845, Samuel C. Coombs, a machinist in the employ of Phelps & Bickford, in company with R. R. Shepard and Martin Lathe, a wood-worker, in the same shop, formed a co-partnership under the style of S. C. Coombs & Co. They started in the Court Mills, then moved to Dr. Heywood's shop. Before they moved C. Wheelock was taken into partnership. From the Heywood shop, in Central Street, now used by the Harrington Brothers as a paint shop, they removed to the Estabrook shop, where they occupied room in the northern end of the building, where their successors, the Lathe & Morse Tool Co., continued until they moved to their own building, in Gold Street, where they are now located. Their business from the start has been the manufacture of lathes and planers. They employ on an average about fifty hands, and their product goes all over the world.

The first exhibit of machinists' tools was made by S. C. Coombs & Co., at the Mechanics' Exhibition held in September, 1851. The first exhibition of the Mechanics' Association was held in the City Hall, Tuesday, September 26, 1848, and the circular announcing it was signed by William B. Fox, William A. Wheeler, Ichabod Washburn, William N. Bickford, Freeman Upham, John Boyden and Samuel Davis.

A. & S. Thayer began at Court Mills in 1845, where they employed ten men in the manufacture of engine lathes. These were an improvement upon the lathes then in use, and attracted much attention among machinists.

A. & S. Thayer moved from Court Mills into Allen & Thurber's Pistol Shop, which stood just south of Merrifield's present engine-house, and was burned in 1854.

They occupied the south-end basement, while Samuel Flagg & Co. occupied the north end. They afterwards moved into the Dr. Heywood building, in Central Street. While there, Sewall Thayer died. Upon his death, A. Thayer associated with him H. H. Houghton and E. C. Cleveland. They moved back into the pistol-shop, and remained in Union Street till the fire, when they removed to Washington Street (present location of the Allen Boiler Works), and continued in business until 1857, when Mr. Cleveland retired. They continued the business at the Washington Street shop until the breaking out of the war, or a little later, and were employing about one hundred and fifty men, and making some of the finest tools in the country, when the business was bought by the New York Steam-Engine Company, and continued a short time under that name, when it was moved to Passaic, N. J., and finally went out of existence.

The firm of Samuel Flagg & Co. was organized in 1847. Mr. Flagg associated with him Henry Holland and two of his former apprentices,—L. W. Pond and Ephraim H. Bellows. They started in the second floor of Heywood's building, in a room twenty feet by forty. They remained there but a short time, until Allen & Thurber's building was ready for tenants, when they moved into the north end; they remained there until 1849, when Mr. William T. Merrifield put up his first brick building; they then moved into the same location now occupied by the Wheelock Steam-Engine Company. Shortly before the fire they took the whole basement, and were burned out in 1854, when they went into the lower floor of the Goddard & Rice factory in Union Street, where they remained until the Merrifield buildings were rebuilt, to which they returned, remaining until 1861.

Prior to this time Mr. Pond had bought out the

others in interest. Meantime J. B. Lawrence, in 1854, built the east end of the building lately occupied by the Pond Machine Tool Company. In 1861 L. W. Pond purchased this, and built the west end, and continued there until 1875, when the business was continued by the Pond Machine Tool Company, which in 1888 removed to Plainfield, N. J. While in Worcester, they maintained a high reputation for the quality of their work, excelling particularly in the production of large tools.

The brothers, Carter Whitcomb (who had been in the employ of Howe & Goddard) and Alonzo Whitcomb (who had been in the employ of S. C. Coombs & Co.) formed a copartnership under the name of Carter Whitcomb & Co., and began the manufacture of copying-presses, in 1849, in the Union Street shop of Howe & Goddard. They occupied room in Merrifield's shop prior to the fire of 1854, when they were burned out; they returned soon after the new building was completed, and later went to the Estabrook building, and from there to the present location in Gold Street.

This was the first successful attempt to establish in this country the business of manufacturing copying-presses. George C. Taft had previously begun the manufacture, but continued only a short time, when it fell into the hands of the Messrs. Whitcomb. These presses have been sold throughout the country, the sales, some years, amounting to five thousand presses. From the first this company has manufactured iron planers, and later commenced the manufacture of shears and punching-machines. The iron planers first made very light and poorly constructed; the gears were cast, the cut-gear was unheard of. This company continues to make copying-presses, iron planers and shears for cutting iron plate for boilers, but their principal business is in planers.

In 1856 Samuel Flagg organized a Machinist Tool Company, composed of Samuel Flagg, Pierson Cowie, Dexter Flagg, Lemuel G. Mason and George H. Blanchard. They only continued in business a short time, but made at their shop, in Merrifield's building, the largest lathe, with one exception, up to that time made in the country. It weighed about thirty-five tons, the length of the ways was thirty-five feet and width eight feet. They also engaged in the manufacture of machines for mortising iron, weighing six tons each, some of which were made for the government.

In the fall of 1861 Joseph A. Sawyer had a little shop in the building known as Heywood's Boot Shop, in Main Street, for repair work and the manufacture of sewing and other machines; subsequently he removed to the second floor of the Union Water Meter Shop in Hermon Street, where he manufactured shafting, pulleys and friction pulleys. In the fall of 1877 he built his present shop, one-story, forty by seventy two feet, and in 1881 he built two additional stories, to furnish room and power to let. Mr. Joseph A. Sawyer was the inventor of a machine for pleating cloth up to eighteen inches in width, which was sold to the Elm City Company, of New Haven, and is said to be the only practical pleating-machine ever invented. Mr. Sawyer invented many devices now used in boot and shoe factories. Since his death, in May, 1888, the business has been continued by his son, who manufactures Sawyer's Combined Hand and Power Planer, and who also does a large business in fitting up corset and boot and shoe shops, putting up the stitching-machines and keeping them in repair. Mr. Sawyer has made much automatic machinery used in the organ and reed business, and makes a specialty of difficult machines for special purposes. Their work is of a varied character, and much of it very delicate.

Parritt Blaisdell, who was with Wood, Light & Co. for fifteen years, built a shop in Jackson Street in 1865 and commenced the manufacture of machinists' tools, with four or five men. Afterwards he took into company John P. Jones, and in 1873 S. E. Hildreth. Mr. Blaisdell died in 1874. His widow sold a part of his interest to Enoch Earle, and all of these partners are in the business at the present time. They have enlarged their shop and increased their business until at the present time they employ about one hundred men.

W. F. Bancroft & Co., established in 1870 by Kent & Bancroft, make self-operating spinning machinery, lathes, planers and special machinery.

William H. Eddy, manufacturer of machinists' tools, established 1873, manufactures planers, twist-drills, grinding-machines, stone, bolt and gear cutters; the twist drill-grinders are his own invention; he has also devised a clutch friction pulley that prevents noise in the changing of belts. He began with two men, but now employs eighteen. Mr. Eddy was contractor for L. W. Pond for twenty-one years.

F. E. Reed, in April, 1875, purchased a half-interest in the concern of A. F. Prentice, who then employed six men in French's building, in Hermon Street. In August, 1877, Mr. Reed purchased Mr. Prentice's interest and continued the business alone. At first he occupied but one floor, but soon added another, and later, built a commodious shop in Gold Street, which was finished in 1883, two stories and a basement, one hundred and eighty by fifty-five feet. The machinery and tools are all new and of the best patterns. One hundred and twenty-five men find employment in this business, and the power is furnished by a forty horse-power Brown engine, while an Armington & Sims engine drives an Edison dynamo which supplies three hundred sixteen candle-power lamps. The principal products of this shop are engine-lathes, ten to twenty inch swing, hand-lathes from nine to sixteen inch swing and a large line of foot-power lathes, with or without screw-cutting attachments. These machines are shipped to England, Germany, Japan, Mexico and to other

countries, and large quantities to all parts of the United States.

Under the names of Boynton & Plummer, 50 Lagrange Street, James Kindred, H. S. Brown and Henry Kindred have, since 1878, manufactured blacksmith drills, bolt-cutting machines and shaping-machines, and are the pioneers in this class of work in the city. Their trade extends throughout the country and to Australia and South America.

In February, 1878, E. H. Wood began to manufacture for Harwood & Quincy, of Boston, the Bramwell Feeder, which is used for feeding the wool into carding-machines. This feeder has revolutionized the work of supplying carding-machines, and has been a great factor in the development of the wool-carding business.

In 1881 their present shop, near the Junction, was completed and the Harwood & Quincy Machine Company was formed. The Bramwell Feeder was invented by W. C. Bramwell, of Terre Haute, Ind.; the entire patent is owned by Harwood & Quincy, who have the exclusive manufacture of the machine. Mr. Edwin H. Wood, the superintendent of this company, was seventeen years the foreman in the shop of Daniel Tainter, formerly a well-known manufacturer of woolen machinery.

In 1879 Mr. W. C. Young, began with one assistant in Mawhinney's building, No. 19 Church Street, the manufacture of shoe tools and edge planes; he now employs twenty hands in the manufacture of engine-lathes, wood-turning and amateur lathes, which he designs himself, exporting a large number.

J. A. Fuller, at No. 3 Cypress Street, makes machinists' tools, lathes, planers and speed-lathes, employing seven men; he also manufactures bench-gears and small dynamos.

Currier & Snyder began in 1883 in Central, and are now at 17 Hermon Street, where they manufacture upright drills. At first they employed but one hand, and now they employ fifteen. The ease and rapidity with which their drills can be manipulated have won for them a high reputation. Both the partners were for many years employed in the Blaisdell shop.

The Powell Planer Company was incorporated in 1887 for the manufacture of machinists' tools, and make a specialty of iron planers. They control patents upon lathe devices, for shifting belts, and for general convenience in operating the machine; and have a system for securing a very fine, even surface for the working parts of their machines by using what they call "surface plates." Starting with three men, they now give employment to fifty.

The tools made previous to 1845 were very much lighter than those made to-day. The beds of the engine lathes were of wood, with strips of iron bolted to them for the ways, and the carriage that held the cutting tool was operated by a chain. Gradually this was superseded by a rack and gears driven by a rod in front of the lathe. Tools have been very much increased in weight and the workmanship is much improved. There has been as great a change in the character of our shops in the last forty years as in their products. Then, a man was expected to begin work as soon as he could see, and to continue until nine o'clock at night, with half an hour for breakfast, an hour for dinner and half an hour for supper. Whale-oil lamps were used; these smoked badly, and made the atmosphere almost unendurable. Pay came but once in six months, and then often in the form of a note,—a strong contrast with the short hours of the present day, steam heat, gas or the electric light and weekly wages in cash.

Agricultural Implements.—It is said that it took the observation of the farmers and the inventive genius of the mechanics of the country, from 1797 to 1842, to decide upon the best form of a plow. It was a subject that seemed to afford endless opportunity for argument and controversy. Thomas Jefferson was much interested in the subject, and in a letter written to Jonathan Williams, in July, 1796, says that he has discovered "the form of a mould-board of least resistance," that he has reduced it to practice, and that his theory is fully confirmed. He gave this subject careful study, as appears from his correspondence.

The first iron plow in Worcester County was made by William A. Wheeler, in Hardwick, in 1822, but plows of some sort were made in Worcester in 1821 and prior to that time by Oliver Wetherbee, who carried on the business in the blacksmith's shop of Levi Howe, and later at his own shop, a few rods from Captain Thomas' inn.

In November, 1823, Mr. Wheeler announces that he will keep on hand all kinds of plows at his shop in Thomas Street.

In November, 1824, the committee, in reporting upon the articles exhibited at the Cattle Show, then lately held, refer to two cast-iron plows exhibited by Oliver Wetherbee, and state that those plows are fast superseding those of the old construction.

Burt & Merrick, in June, 1828, appear as agents of the Hitchcock plow, claimed to be superior to those previously used, and in 1829 Benjamin Butman & Co. had for sale, "Nourse's Cast-Iron Plows." These plows were manufactured by J. & J. Nourse, at Shrewsbury, and were known as the Hartford Cast-Iron Plows.

In April, 1833, C. Howard's cast-iron plows are offered for sale by G. T. Rice & Co., and, at the same time, Mr. Wheeler announces that he has "just received an assortment of plow-points from the various patterns heretofore cast at Brookfield." Meantime, Mr. Joel Nourse appears to have moved from Shrewsbury to Worcester, and to have taken a shop in Thomas Street, for in August, 1833, he there offers for sale plows of the most approved construction and of five different sizes. He also offers for sale in March, 1834, his "side-hill plows." Mr. Nourse seems to

have been a successful manufacturer of plows, for in its report, the committee at the Cattle Show, in 1835, compliment him highly, and say that all the plows on the field except three were of his make.

J. Nourse & Co., March, 1836, added the manufacture of cultivators to their business, and in March, 1838, Ruggles, Nourse & Mason, a firm composed of Draper Ruggles, Joel Nourse and J. C. Mason, announce that they have made arrangements for manufacturing on an extensive scale the most improved form of cast-iron plows, and that they have secured Jethro Wood's patent on the same, and add,—"Most of the cast-iron plows are made too short, and are too concave for the mould-board to run easily." Ruggles, Nourse & Mason make plows for turning over green sward, turning over stubble; and also make three sizes of the celebrated side-hill plows; also, improved seed-sowers, improved expanded cultivators, and Coats' patent revolving hay-rake.

The first plow made by Nourse and others was a clumsy affair; the mould-board and standard were of iron, the rest of wood.

Ruggles, Nourse & Mason were in Thomas Street, at first, about opposite the present location of the City Water-works Shop; afterwards Mr. Samuel Davis induced them to move to Court Mills, where increased facilities enabled them to largely extend their business.

The next new implement made by Ruggles, Nourse & Mason was the Wilkes revolving horse-rake. They were constant exhibitors at the Cattle Shows, and in 1851 showed over twenty different kinds of plows. This industry was a most important one. Worcester, at that time, is said to have been more largely engaged in the manufacture of agricultural implements than any other city or town in the United States, and the business had been entirely developed within a comparatively few years; for there were those living who remembered the stub hoes and wooden plows, while the sensation of first seeing the cast-iron plow was fresh in the recollection of many farmers in the county. Ruggles, Nourse & Mason at this time, 1851, occupied the Court Mills, the main building being of brick, two hundred and fifty feet long, seventy-five feet wide and four stories high, and employing about two hundred hands. The motive-power was partly steam and partly water, supplied by Mill Brook. The same turbine wheel is still used for power in E. W. Vaill's chair factory.

The white oak timber used was furnished by Oakham, Paxton, Sterling and other towns. The iron castings were made in an adjoining building, and three tons of iron were used daily. The product was sold in Boston, where the sales-room occupied the second story in Quincy Market, and where were displayed upwards of three hundred different patterns of plows alone, to say nothing of other agricultural implements and dairy equipment.

Among the recipients of medals at the Crystal Palace Exhibition in New York, in 1854, was the Worcester Shovel Company, for Kimball's patent shovels with malleable iron sockets; and Ruggles, Nourse & Mason for Armsby's patent corn shovel, for Perry's patent meat-cutter and a vegetable-cutter; also, for double soil and subsoil plow. In 1855 they offer mowing-machines for sale.

April 1, 1856, Ruggles, Nourse & Mason were succeeded by Nourse, Mason & Company, consisting of Joel Nourse, Peter Harvey and Samuel Davis.

After a time Nourse, Mason & Company sold out to Mr. Nourse, who organized a company consisting of Joel Nourse, Peter Harvey and Sampson & Tappan, of Boston, doing business under the name of Nourse, Mason & Company. Meantime, they had started a shop at Groton Junction, where they were increasing their capacity as well as employing all the labor that could be accommodated at the Worcester factory. In 1859 they were employing two hundred and fifty hands; their pay-roll amounted to eight thousand or nine thousand dollars per month, and they had increased their power by putting in a sixty horse-power engine.

In 1860 the works were purchased by Oliver Ames & Sons, and, in 1874, moved to the large brick factory in Prescott Street, where they are now in operation, under the name of the "Ames Plow Co." They manufacture all kinds of agricultural implements, power-machines, meat-cutters, etc. In 1887 they made seven thousand wheelbarrows. They make seven thousand plows yearly, and employ one hundred and seventy men.

In 1857, J. T. Adriance & Co., manufactured Manny's improved mowing-machine, and during that year made about six hundred of them. Alzirus Brown, in 1858, also manufactured these machines and Manny's reaper, employing about forty to fifty hands.

In September, 1859, J. M. C. Armsby, who had previously been a partner in Nourse, Mason & Co., completed his building in Central Street, for the manufacture of plows, cultivators, harrows, horse-rakes, hoes, etc. It was one hundred feet long, thirty-five feet wide and four stories high, with two wings extending back—one seventy-four and the other fifty feet. An engine of twenty-five horse-power, made by the Putnam Machine Company, was the only piece of machinery in the building not of Worcester manufacture.

A patent was granted, December, 1861, to L. G. Knitfen, of Worcester, on his Union Mower. He formed a company for its manufacture, to be known as the "Union Mowing-Machine Company," Alzirus Brown, agent.

The Wrench Business.—The water privilege at New Worcester, occupied by the two factories of the Coes Wrench Company, are, historically, of considerable interest.

Captain Daniel Gookin, who was one of the com-

missioners appointed by the General Court, October 11, 1665, to survey the country in the vicinity of Lake Quinsigamond, to determine if there be a "meet place for a plantation, that it may be improved for that end, and not spoiled by granting of farms," was the original owner of this property, and from him Mr. Loring Coes' great-grandfather had a deed of this water-power and built a saw-mill at the upper dam, where previously there was a beaver dam.

On the site of the Leicester Street mill, wool and carding machinery was built from an early day. This privilege came into the hands of Moses Clements, and from him passed to William Stowell, who also made woolen machinery, carding machinery and jacks. From Stowell the privilege passed to Thomas Harbach, at one time associated with Joseph Converse, then to Edward and Martin Wilder, from whom it was purchased by L. & A. G. Coes, in 1848. At the southwest end of the Leicester Street Works was the old Clements building, of wood, two stories high and fifty or sixty feet long. It was later taken down by the Coes'. The building at the northeast end, still standing, was erected by William Stowell, about 1835, and was at one time occupied by Kimball & Fuller, in the manufacture of woolen machinery. Loring and A. G. Coes were both born in New Worcester, and both worked for Kimball & Fuller. In 1836 the brothers formed a copartnership and purchased this business, which, meantime, in November, 1835, had been moved from New Worcester to Court Mills. Here they continued until October, 1839, when the Court Mills were destroyed by fire. This loss so far impaired their capital as to prevent their starting again. Their fellow-tenants also burned out were, Samuel Davis, builder of woolen machinery; Ruggles, Nourse & Mason, manufacturers of plows and agricultural implements; H. W. Miller, punching-machines for manufacturing nuts, washers, etc., and Thomas E. Daniels, builder of planing-machines.

After the fire the brothers went to Springfield, Mass., and engaged as pattern-makers in the foundry of Laurin Trask;[1] while there employed they made a model of a new and improved form of the wrench, a tool which they constantly used. There were at that time two styles—one of English invention, and the other known as the Merrick or Springfield wrench. The mechanism of both these wrenches was such that both hands were used to open or close them. This was often inconvenient, as it was important to so adjust the wrench to different openings, by the hand in which it was held, as to leave the other hand free for other demands of the work. It occurred to the Coes Brothers to dispense with the screw on the shaft, as in the Merrick wrench, and affix by the side of the shaft, a small bar in the form of a screw, which should enter another screw formed in the lower or movable jaw of the wrench; and that the first screw should also have, at its lower end, where it should enter the handle, a rosette always in reach of the thumb of the hand that held the wrench.

This rosette, being pressed and turned by the thumb would operate the screw, and the opening and closing of the wrench would easily be effected by one hand. It seemed to them that this adjustment would make the tool much stronger by removing the indentations from the bar or shaft, and that there would be less liability of injury to the wrench from severe or improper use.

In November, 1840, they returned to Worcester, and at once directed their efforts to securing a patent for their invention. The patterns of their spinning machinery had been saved from the fire, and these they sold to Samuel Davis, a manufacturer of woolen machinery, and so obtained the means for securing a patent, which was granted to Loring Coes, April 16, 1841.

The brothers now formed a co-partnership under the name of L. & A. G. Coes, for the manufacture of wrenches under this patent. They were without capital, and Henry W. Miller, a hardware dealer in Worcester, aided them by fitting up a shop (in the northwest end of Court Mill, in Mr. Miller's shop), with the requisite machinery and tools, of which he retained the ownership, taking and selling all the wrenches manufactured by the Messrs. Coes. The business was so far successful that early in 1843 they were able to purchase the machinery and tools. They were now employing three hands, and made a contract with C. Foster & Co. to sell their goods. The next winter (1843–44) they moved to the shop of Albert Curtis, in New Worcester. They leased a basement in one of Mr. Curtis' buildings who built them a blacksmith shop, and put in a trip-hammer for their use.

At the close of their contract with C. Foster & Co., April 1, 1848, they entered into a contract for five years with Ruggles, Nourse & Mason. At this time, also, they bought for fifty-five hundred dollars the old woolen-mill in which they had both worked in their youth—the water privilege, two houses and about four acres of land. They were now employing from twelve to fifteen men, and making from five to six hundred wrenches a month. They repaired and raised the mill and put in a new water-wheel and new machinery.

"Their contract with Ruggles, Nourse & Mason expired, by limitation, April 1, 1853, and they thenceforward sold their own goods. They had, during the twelve years since their first patent was granted, devised, individually or jointly, various improvements in the wrenches and in the special machinery used in their manufacture.

"On July 21, 1853, with Levi Hardy, they purchased from Moses Clement his shop, machinery and business—that of the manufacture of shear-blades and knives for hay-cutting machines. The co-partnership continued until May 2, 1864.

[1] Van Slyck, "New England Manufacturers and Manufactories."

"After the dissolution of their co-partnership, having purchased Mr. Hardy's interest in it, they continued the business, with Charles A. Hardy as the superintendent of the shop, keeping its accounts distinct from those of the wrench business.

"In 1865 they built a dam half a mile above their water privilege, to form a reservoir, and the next year they built a shop at the reservoir, one hundred feet by forty, two stories high, with a basement, devoting it exclusively to the manufacture of shear-blades, hay-cutter knives and similar articles.

"In 1867 they built a new dam one hundred rods below the reservoir."

On April 1, 1869, they dissolved their co-partnership and divided the business—Loring Coes taking the upper privilege, including the shear-blade business, and A. G. taking the lower privilege, and paying a bonus for the right of choice. At this time they sold monthly from ten to twelve thousand wrenches.[1]

L. Coes & Company erected the large brick factory at the lower dam, one hundred feet long, fifty feet wide and four stories high, with basement and attic. The building, with the machinery to be used in it, was finished early in 1871.

The Coes Wrench Company is a consolidation of the two companies, which was effected April 1, 1888, with Loring Coes, president; John H. Coes, treasurer, and Frederick L. Coes, secretary—the two latter, sons of A. G. Coes. They are now manufacturing wrenches under patents of Loring Coes, dated July 6, 1880, and July 8, 1884; are producing fifteen hundred wrenches per day and employ one hundred hands.

At the outlet of the upper pond Mr. Loring Coes carries on quite an extensive business in the manfacture of die stock for cutting sole-leather and other purposes. He also makes shear-blades, knives for meat, cheese-cutters and lawn-mower knives. He has a trip-hammer in this shop, and the old rolling-mill, used for making plane irons, by William Hovey, on the mill dam in Boston many years ago.

L. Hardy & Co., at New Worcester, conducted by Henry A. Hoyt, manufacture shear-blades, die stock for cutters, &c., and John Jacques, at New Worcester, manufactures patent shears for book-makers, binders, printers and paper-box makers; also shears for tin-plate workers.

Other manufacturers of wrenches, in a small way, have engaged in the business from time to time. In April, 1852, E. F. Dixie advertises to manufacture "Hewet's celebrated screw-wrench." George C. Taft and John Gleason manufactured wrenches, in connection with copying-presses, at Northville, in 1853. B. F. Joslyn, who seems to have been a most ingenious mechanic, and who made several inventions in fire-arms, made several improvements in wrenches, and on one of these, at least, procured a patent.

[1] Van Slyck, "New England Manufacturers and Manufactories."

Ruggles, Nourse & Mason, who were at one time selling agents for the Coes', manufactured wrenches in 1859, in connection with the business in agricultural implements.

CHAPTER V.

MANUFACTURING AND MECHANICAL INDUSTRIES.

Wire—Wire-Workers—Copperas.

WIRE.—In the latter half of the eighteenth century the desirability of commencing the manufacture of wire in this country was very generally recognized. But little progress was made for some years, and most, if not all, of the card-wire was imported from England. In fact, at this time there was very little wire made in the world. From a well-authenticated source the assertion is made that in 1810 the entire output of wire in England would not exceed one four-horse load weekly.

From the report of Albert Gallatin, then Secretary of the Treasury, made in 1810, it appears that the demand for cards was twice as much in 1809 as in 1808, and was increasing.

The wire is imported, and serious inconvenience would attend the stoppage of the supply, although the manufacture might, and would be immediately established to supply all demands, if the same duty were laid on wire, now free, as on other articles of the same material.

In the early days the hardware dealers of Worcester imported their wire from England or Germany. Wire was drawn in Walpole, soon after the Revolution, by Eleazar Smith, and card-wire was drawn by hand in Leicester as early as 1809. In 1813 mention is made of a wire factory, run by Joseph White, in West Boylston; in April, 1814, of its manufacture in Phillipston, and in the same year a wire factory is advertised for sale at Barre, on the Ware River.

Prior to 1815 a building on the present site of the Coes Wrench Factory, Leicester Street, New Worcester, was occupied as a wire factory.

Wire was drawn in Spencer between 1815 and 1820. Its manufacture in Worcester was begun in 1831 by Ichabod Washburn and Benjamin Goddard, in a wooden factory at Northville. This was on the second privilege south of North Pond dam, and was built by Frederick W. Paine. The factory now standing on this site is the third one built there, the two preceding having been burned.

Ichabod Washburn first engaged in business in Worcester in 1820, with William H. Howard, in the manufacture of woolen machinery and lead pipe. Mr. Howard shortly afterwards left town, and Mr. Washburn purchased his half of the business, which he continued.

The demand for woolen machinery increasing, Mr. Washburn, in 1822, took as partner Mr. Benjamin

Goddard, the firm being Washburn & Goddard, and they soon employed thirty men. They made the first condenser and long-roll spinning-jack ever made in Worcester County, and among the first in the country.

Any one passing in Main Street, by the head of School Street, in the year 1822, might have seen projecting from one of the large sycamore trees standing there, the following sign:—WOOL CARDING AND LEAD AQUEDUCT MANUFACTORY, with a hand pointing down the street to Washburn & Goddard's shop, on the site now occupied by N. A. Lombard's building, and near the site of the factory for the manufacture of corduroys and fustians, occupied in 1789 by Samuel Brazer.

During the winter of 1830–31 Mr. Washburn, in a small wooden building, back of what is now the brick part of N. A. Lombard's factory, in School Street, experimented in the manufacture of wood-screws.

Some time during the year 1831, Mr. Washburn, Mr. Goddard and General Heard visited North Providence, where three brothers—Clement O., Curtis and Henry Read—were making wood-screws under a patent which they owned. An arrangement was made with the Reads, and they moved the screw machinery to the Northville Factory at Worcester. It was brought from Providence on a canal-boat, the journey occupying three days.

Meantime, in August, 1831, Washburn & Goddard sold their business in School Street, and moved to Northville, where the manufacture of wire and wood-screws was begun, the wire being manufactured by Washburn & Goddard, the screws under the name of C. Read & Co., with whom Mr. Washburn had an interest. Washburn & Goddard at the same time manufactured card-wire.

Some time between April, 1836, and March, 1837, the screw business was removed to Providence, where it continued for a time under the name of C. Read & Co., but ultimately became the nucleus of the "Eagle," now the "American Screw Company," which has since acquired a world-wide reputation.

Mr. Washburn states, in his autobiography, that the first wire-machine he ever saw was one of self-acting pincers, drawing out about a foot, then passing back and drawing another foot. With this crude machine a man could draw about fifty pounds of wire per day. For this Mr. Washburn substituted the wire-block, which is in use at the present time.

The process of wire-drawing consists in taking a coarse wire rod and drawing it through a hole of less diameter than the rod, in an iron or steel plate, and repeating the operation until the rod is reduced to wire of the required size. The reduction is effected by stretching the wire, and not by removing the metal.

At the present day a piece of steel four inches square and three feet long is rolled into a two hundred pound coil of No. 6 rods, measuring about two thousand and forty-six feet. This rod, by the process of drawing from No. 6 to No. 12, is increased in length to 6,848 feet. The diameter of the No. 12 wire is .105, while the billet from which it is made has a sectional area of sixteen square inches.

Mr. Washburn, at this time, happened to be in New York, when Phelps, Dodge & Co., with whom he had business, said to him that they were starting a wire-mill, and expected to make all the wire that would be wanted in the country, and predicted failure for his mill in Worcester.

January 30, 1835, the partnership was dissolved, Mr. Goddard retaining the factory at Northville for the manufacture of woolen machinery, while Mr. Washburn continued the wire business in a factory built for him, by the late Stephen Salisbury, on Mill Brook, which was dammed for the purpose of providing water-power, thus forming what is now known as Salisbury's Pond. The earth removed to make a basin for the pond forms the high ground now found upon the south side and included within the boundaries of Institute Park.

The building erected by Mr. Salisbury was eighty feet long and forty feet in width, three stories high in the centre, with a sloping roof, two chimneys and surmounted by a cupola containing a bell.

In 1835 Charles Washburn came from Harrison, Me., where he was practicing law, and formed a co-partnership with his brother Ichabod, which continued until January 13, 1838. Meantime Benjamin Goddard discontinued the manufacture of woolen machinery, and the Northville mill came into Mr. Washburn's possession. He then made a contract with Mr. Goddard to draw wire for him, and wire machinery was again set up in the Northville factory.

About the year 1840 Mr. Washburn bought the water-power and property now occupied by the Worcester Wire Company at South Worcester. Mr. Goddard took charge of the mill, and retained that position till his death, in 1867, and all three of his sons worked there,—Delano, who afterwards became the accomplished editor of the *Boston Advertiser;* Henry, who is now at the head of an important department at the works of the Washburn & Moen Manufacturing Company; and Dorrance, who for many years was superintendent of the South Works of the corporation.

The South Worcester Mill was a one-story building, about fifty feet long and thirty feet wide. Card-wire was here drawn to No. 19 size, and brought to Grove Street to be finished. Coarser wire, for machinery and telegraph purposes, was also drawn at South Worcester.

At the Worcester County Cattle Show, held in October, 1838, Ichabod Washburn exhibits very excellent wire Nos. 30, 31, 32 and 33, and also iron wire cards.

In 1842 Charles Washburn again became a partner in the business. February 13, 1845, the old wire-mill in Northville, then used as a cotton-factory and

occupied by William Crompton, was totally destroyed by fire.

In February, 1847, Prouty & Earle had a wire-factory at Washington Square; subsequently it was purchased by I. & C. Washburn.

At this time the demand for telegraph-wire commenced. From 1847 until 1859 it was mainly of No. 9 size, Stubs' gauge. It was not galvanized at first, but was sometimes painted or boiled in oil, for the purpose of retarding the inevitable process of oxidation. A more complete preservative was later found in zinc, applied by the process known as galvanizing. At first this was somewhat crude, and consisted in dipping the coils of wire in molten zinc, after which the surplus metal was shaken off by violent pounding.

From 1837 till 1847 Ichabod Washburn purchased in Sweden his wire-rod billets, which were bars of iron about twelve feet long, one and one-eighth inch square in section, and these were rolled into wire-rods at Fall River, Troy and Windsor Locks, Conn. The inconvenience of having the rolling done at a distance led Ichabod and Charles Washburn, in 1847, to look about for a location for a rolling-mill.

Attracted by the water-power at Quinsigamond, a small part of which was then used by the lower paper-mill remaining at that place, they purchased the whole property of the Lincoln family, thus acquiring what they deemed reliable power, and, at the same time, plenty of room for the location of all the buildings necessary for their purposes.

Under their patronage a new firm was organized to carry on the rod-rolling and wire business, under the title of Washburn, Moen & Co., a firm composed of Henry S. Washburn, Charles Washburn and Philip L. Moen. This company was dissolved January 12, 1849, the business being continued by Henry S. Washburn.

January 1, 1849, the co-partnership theretofore existing between I. & C. Washburn was dissolved, the manufacture of wire in its various branches being continued at the Grove Street mill by Ichabod Washburn. A division of the property was had, Charles Washburn taking Quinsigamond. February 9, 1849, he offered to rent for a term of years "the building with water-power sufficient for driving machinery for a sash and blind-factory, or any other business not requiring a very great water-power." At the same time he offers for sale the entire machinery for the manufacture of paper in the said building.

This was the lower of the two paper-mills, which for many years had been run at this point by the Burbanks, and was located in what is known as the scrap-yard of the Washburn & Moen Manufacturing Company, about forty feet south of a well, which is now constantly in use and which afforded water for the operatives in the paper-mill. The end of the mill was parallel with the railroad, and was only separated from it by the width of the old race-way, and stood at a point about four hundred and sixty feet southeast of the traveled highway, as it crosses the railroad.

April 1, 1850, Philip L. Moen became a partner with Mr. Ichabod Washburn, and has been actively engaged in the business from that time.

In July, 1851, a Mr. Adams had a wire-factory opposite the Norwich depot, but no further notice of it is to be found.

January 2, 1853, Henry S. Washburn formed a co-partnership with Charles F. Washburn, and they continued at Quinsigamond rolling rods and manufacturing iron and wire under the firm-name of Henry S. Washburn & Co. Meantime, Ichabod Washburn had made considerable progress in the manufacture of wire, particularly of card-wire, introducing new and improved processes. This was made of Swedish bars one and one-quarter inches square, which were rolled at Quinsigamond into wire rods of a little less than one-quarter of an inch in diameter; they were then carried to the wire factory at South Worcester and Grove Streets, and drawn to the necessary sizes. The capacity of this rolling-mill was about six long tons per day of ten hours.

Early in his experience as a wire-drawer Mr. Washburn adopted certain improved processes for annealing,—that is, restoring the wire, as it became hard and brittle, by repeated drawing to its original soft and pliable condition,—by heating in cast-iron pots and cooling slowly. This improvement consisted in placing the small coils in double air-tight iron-pots.

In 1850, at the suggestion of Mr. Chickering, of Boston, Mr. Washburn devoted his attention to the production of steel wire for piano-fortes, the manufacture of which had been previously monopolized by several English houses. These experiments were successful; and the English wire was discarded for that made in Worcester.

From that time to this the Washburn & Moen Company has been the only manufacturer of music-wire in this country.

In February, 1856, the Quinsigamond Mills consisted of a building one hundred and fifty feet front with two wings extending back one hundred and fifty feet, between which was a hoop building, sixty by thirty feet; these with coal-houses and yards covered more than an acre of ground. Here were manufactured Brazer's screws, rivet rods, bright and annealed market and telegraph, spring, fence, buckle and bail wire; also fine hoops. The daily product was ten tons; eighty-five operatives were employed and one hundred horse-power was supplied by three water-wheels. The annual product of the mill was valued at three hundred thousand dollars.

The first continuous tempering done by Mr. Ichabod Washburn was in 1856, in the rear of his Summer Street residence; this was music wire, and the hardening was done in water. Early in 1857 the furnace was removed to the old gymnasium in Orchard Street and oil was substituted for water.

This series of experiments led to an important invention in the process of hardening and tempering continuously. Hitherto this had only been done when the steel wire was in the form of a coil by subjecting it first to high heat, and then cooling in oil or water.

But the pressure for music wire and for crinoline wire now coming upon him, the old process became too slow and expensive to be endured, and it became necessary to adopt some more efficient method. This was found in the continuous process of hardening and tempering, which he patented, and which, without any substantial improvement or change has been universally adopted, rendering possible many results which could not otherwise have been reached.

In 1857 the partnership of Henry S. Washburn and Charles F. Washburn was dissolved, and May 1st, of that year, Charles Washburn and Charles F. Washburn formed a co-partnership under the name of Charles Washburn & Son, and continued in business at the Quinsigamond works. Henry S. Washburn remained in the wire business, and occupied as a factory one of the buildings erected by Nathan Washburn near the freight depot of the Western Railroad.

C. Washburn & Son then manufactured most of their common market wire from scrap iron piled on boards eighteen by eight inches, heated to a welding heat, and rolled into billets which were re-heated and rolled into rods.

The only appliances in their mills for the production of wire rods were three heating furnaces and a large train of two rolls, in which the pile of heated scrap was rolled to one and one-eighth inch billets of one hundred pounds weight; and a small train of rolls three high, by which these billets were rolled to three and a half by four Stubs' gauge wire rod.

Experiments in the burning of peat were made by Henry S. Washburn & Co., and by I. Washburn & Co., but it did not prove a satisfactory substitute for coal.

In July, 1859, I. Washburn & Company employed one hundred and twenty hands in the Grove Street mill, and made three tons of iron wire per day. They were erecting a new mill three stories high, eighty feet by forty feet, and were also making large additions to the mill in South Worcester; a new annealing house, fifty feet by thirty feet, two stories high, together with additions to the main building.

Crinoline Wire.—The crinoline wire business commenced about 1859 and lasted for ten years. This was made possible by the continuous hardening and tempering process invented by Mr. Washburn, which made it feasible to temper a cheaper grade of cast steel at very little additional cost, and thus substitute it for the more expensive methods before used for increasing the size of women's skirts. This enabled the skirt-makers to put their goods on the market furnished with steel hoops of great toughness and elasticity, and at a price which put them within the reach of the poorest; consequently, this line of business was largely increased until about 1870, when other fashions came into vogue and the consumption of tempered steel in this form steadily decreased. For several years the annual output of tempered crinoline wire was one thousand five hundred tons annually, making this company the largest consumer of cast steel in the country.

About 1860 Mr. Washburn introduced continuous annealing, cleaning and galvanizing. This was an English invention and a great improvement upon the processes previously used, being of especial value at that time in the manufacture of telegraph wire.

In November, 1862, the iron and wire works of Chas. Washburn & Son, Quinsigamond, were totally destroyed by fire.

In 1863 I. Washburn & Moen built a cotton-mill, which was run for about ten years, producing yarn sufficient to cover four tons per day of tempered crinoline wire.

In 1864 I. Washburn & Moen controlled the works at Grove Street and South Worcester, but had no rolling-mill. Their business was confined to iron and cast steel of different grades, Bessemer steel and open-hearth steel being introduced many years later.

January 2, 1865, I. Washburn & Moen changed the co-partnership to a corporation under the style of I. Washburn & Moen Wire Works, organized for the purpose of manufacturing wire and wire rods. Capital stock, $500,000.

August 4, 1865, the Quinsigamond Iron & Wire Works, which succeeded to the business of Chas. Washburn & Son, was organized.

November 27, 1866, a petition was filed to form a corporation "for making wire and wire rods, cotton yarn and goods, with a capital larger than at present allowed." The petitioners asked to be incorporated under the title of Washburn & Moen Wire Works, with a capital of $600,000.

July 7, 1867, the mill at South Worcester was burned and the business was conducted at Grove Street till March, 1868, when a new mill at South Worcester was in readiness. About a year and one-half from that time the company commenced the erection of most of the present buildings in Grove Street. Meantime, February 24, 1868, the Quinsigamond Iron & Wire Works and the Washburn & Moen Wire Works were consolidated under the name of the Washburn & Moen Manufacturing Company, with a capital of $1,000,000, and authority to increase this amount to $1,500,000, the present capital, was granted May 26, 1869.

In the fall of 1869 was built the first rolling-mill, at Grove Street. This was a "Continuous Mill," so called, and was in its essential features an English invention.

The adoption of Bessemer steel, which occurred in 1876, created a revolution in the wire business, substituting, as it did, a better and cheaper material for

very many purposes. This occurred at the beginning of the barbed wire business. The use of Bessemer steel for this purpose alone, besides furnishing a stronger wire than could be made from Swedish iron, represents a saving of at least four million five hundred thousand dollars annually to the farmers of the country.

BARBED FENCING.—The importance of the fence question to the people of the United States can perhaps be best appreciated by a mere statement of the results contained in the Report of the United States' Department for Agriculture for 1871, from which it appears that the cost of fencing in thirty-seven States had amounted to $1,747,549,931, while the annual cost of repairs amounted to $93,963,187. This together with the annual interest on the original investment at six per cent., made the total cost, exclusive of rebuilding, $188,806,182.

The cost of fencing per rod, as stated in this report, varies from 30 cents in Alabama to $2.20 in Rhode Island. In addition, a fence occupies and wastes, upon an average, a piece of land half a rod wide, or one acre in every fifty, making a total of not less than 50,000,000 acres in the United States.

Not only was the expense of fencing with timber enormous, but apprehension was felt that the supply might be unequal to the demands made upon it. Wire as a fencing material was recommended as early as 1821. Speaking of the wastefulness of the common method of wooden-fencing, the secretary of the New York State Agricultural Society for 1850 stated that the worm-fence took "from every one hundred acres an area of five acres."

The substitution of wire for wood as a fencing material was generally recommended on the ground that it takes up no room, exhausts no soil, shades no vegetation, is proof against high winds, makes no snow-drifts, and is both durable and cheap.

As the necessity for a cheap fencing material increased, efforts to supply the need also increased. Up to 1881 twelve hundred and twenty-nine patents had been issued relating to fencing, and more than two-thirds of that number since 1865.

The first patent was in 1801, and up to 1857 about one hundred had been issued, while in 1866, '67 and '68 three hundred and sixty-eight fence patents were issued.

In examining the patents issued it is found that of the twelve hundred and twenty-nine issued up to 1881 forty were to inventors in the New England States; three hundred and seventy-two to the Middle States; one hundred and eight to the Southern States; and six hundred and ninety-six to the Western States; eight to the District of Columbia and five to Canada.

Of the States, Ohio had the greatest number, two hundred and forty-one; followed by New York, two hundred and thirty-one; Illinois, one hundred and forty-two; Iowa, ninety-six.

Up to 1873 plain No. 9 round wire was largely used in the West as a fencing material and thousands of tons of it were in use, but it was not satisfactory. It stretched in warm and contracted in cold weather, which was the cause of constant breakages; furthermore, cattle could rub against it with impunity, and this constant pressure loosened the posts and broke the wire.

In the fall of 1873 the manufacture of barbed-wire was begun in a small way at DeKalb, Ill., by Mr. J. F. Glidden, who was a farmer in that town. He first made a few rods of fencing and put it up on his own farm in November, 1873. The process was very crude when compared with the present method of manufacture.

The barbs were first formed by bending around a mandril and then slipped upon one wire of the fence; the second wire was then intertwisted with the first; this locked the barbs in place and prevented lateral as well as rotary motion. The fencing was made in sixteen-foot lengths, and as there was no means for coiling it on spools for transportation, it was carried to the point where it was to be put up, and then enough of these sixteen-foot lengths were spliced together to give a fence of the desired length. The first piece actually sold for use was in the spring of 1874. Three boys and two men were able to make fifty pounds per day. In June, 1874, it was arranged to do the twisting by horse-power, and this increased the product of three boys and two men to one hundred and fifty pounds per day.

In the latter part of 1874 a rude hand-machine was devised for twisting the barb upon the main wire and spooling the product, which was subsequently unwound and twisted with a second wire and then spooled again. By the use of the latest machinery, one man will now produce two thousand pounds, or over five and a half miles, in ten hours.

In the spring of 1876 the attention of the Washburn & Moen Manufacturing Company having been called to this new article of manufacture and impressed with its value, automatic machinery was constructed and patented, and the control of the underlying barbed-wire patents was acquired. These patents were,—one to L. B. Smith, of Ohio (June 25, 1867), in which the barb consists of four radially projecting points from a hub, which is prevented from moving laterally by a bend in the main wire. Patent granted to W. D. Hunt, of New York, in which a single fence wire is armed with spur wheels which can revolve upon the main wire. Patent to Michael Kelly, of New York, dated February 11, 1868; this is the first patent to show two wires twisted together. The barb was made of a lozenge-shaped piece of sheet metal and was strung upon the main wire, while for strength, a second wire was intertwisted with the first. This inventor showed a most intelligent conception of the subject matter of his invention, as appears from the following quotation taken from his specifications

I can, by this invention, make an efficient fence from unconnected wires, six inches apart, fixing the artificial thorns on the wires four inches apart. This fence takes only one-fourth as much wire as in ordinary wire fences, yet it is more efficient. This fence will weigh about one-eighth as much as ordinary connected wire fence, by which I mean those woven or twisted together. It can be wound on a reel, like telegraph wire, and a farmer can transport as much in a single wagon-load as will serve to build fences for a large farm.

The next patent in point of date, and chief in importance, is the patent to Glidden, dated November 24, 1874, in which is for the first time found a barb made of wire wrapped about a fence wire, and locked in place by a fellow wire intertwisted with the first. Meantime, barbed wire was growing in popularity; at first, strong prejudices had to be overcome. Many hardware dealers would not have it in their stores. The public, too, had to be educated. A length of barbed wire, with two barbs upon it, was shown to two men in Texas; one guessed it was a model of a fence, the barbs being the posts, and another thought it was a bit for a horse.

A skeptical farmer said he didn't believe it amounted to much; that he had a bull (Old Jim) who would go through anything, and he guessed he wouldn't stop for barbed wire. His field was fenced; "Old Jim" shook his head, elevated his tail, and went for it. The farmer was converted, and so was "Jim."

Barbed wire, once introduced, grew rapidly in favor. In fact, it became a necessity; strong, durable, cheap, easily transported, and an absolute barrier against man and beast, it became at once the best fencing material known, and the demand for it rapidly increased. Meantime, infringers began to spring up, and litigation followed. No stronger or more persistent efforts were ever made to break down a patent property than were directed against the barbed wire patents.

Thousands of pages of testimony were taken upon alleged cases of prior use all over the West and in Texas. The greatest interest was taken in the cases involving, as they did, the control of what even then bade fair to be a most important industry.

The defence relied upon establishing the alleged cases of prior use, and also insisted strongly that there was no invention in arming a wire with pricking spurs. The United States Circuit Court for the Northern District of Illinois, in December, 1880, sustained the patents, and this gave the Washburn & Moen Manufacturing Company, and their associate, Isaac L. Ellwood, of DeKalb, Ill., the control of this business. Licenses were issued to most of the parties lately infringing, and the business has been conducted upon that basis up to the present time, and will be during the life of the patents, some of which do not expire for several years.

To protect themselves and their licensees, the Washburn & Moen Manufacturing Company has purchased upwards of two hundred and fifty patents upon barbed wire and barbed wire machinery.

The amount of barbed wire consumed in this country has increased from five tons, in 1874, to a probable output of one hundred and fifty thousand tons, over eight hundred and fifty thousand miles, in 1888. Of this amount, the Washburn & Moen Manufacturing Company makes about eighteen thousand tons (over one hundred thousand miles), while the capacity of their works is seventy-five tons per day of ten hours, or four hundred and twenty-six miles. The cost to the consumer has during this time been reduced from eighteen cents per pound to less than five cents. This has resulted from the reduced price of wire and the introduction of automatic machinery.

Bale Ties.—About the time that barbed wire began to be manufactured the company became the owners of patents upon bale ties, a wire substitute for the wood and rope previously used. There are probably to-day ten thousand tons used annually for binding hay in the United States.

Each ton of wire will wind three hundred and thirty tons of hay or straw, and the whole ten thousand tons of wire will bind three million three hundred thousand tons of hay and straw.

It formerly cost on an average to press this amount, when bound with rope, two dollars per ton. Wire is applied to the bales with so much greater ease than wood or rope, that a saving of fifty cents per ton, at a low estimate, is effected in pressing hay when wire ties are used. But the greatest saving made to the public by the introduction of wire for binding purposes is in the increased security against loss by fire. When hay, straw or tow are bound with rope or wood, each is easily set on fire, the binding materal burns, and thus allows the compressed mass to become loose and add fuel to the flames. This, of course, is not the case when wire is used. For this reason, rope and wood were discarded many years ago in pressing cotton.

Altogether, millions of dollars are saved annually to the public by the introduction of wire ties, all of which has been effected in the last twelve or fourteen years.

Copper Wire.—Since 1884 copper wire has taken a prominent place among the products of this company, as it has been and is being largely substituted for iron, particularly in long-distance telephoning and electric lighting.

Copper has always been preferred to iron for electric purposes by reason of its greater conductivity, but previous to the introduction of hard-drawn copper wire it did not possess the requisite strength. By present processes a copper wire of sufficient strength can be produced much lighter than iron, and of largely increased conductivity, as is apparent when the fact is stated that for a given length of wire an equal degree of conductivity will require five times as much weight in a mile of iron as of copper wire.

In January 1884, there were probably not more

than one hundred or two hundred miles of hard-drawn copper wire in use in this country. To-day there are, it is estimated, at least fifty thousand miles, representing about four thousand two hundred tons of metal, now in operation by the various telegraph and telephone companies, the average weight per mile being about one hundred and seventy pounds.[1]

The larger sizes of copper wire are used in connection with electric railways.

Wire Rope.—Among the more recent specialties introduced by the company is wire rope, of which is manufactured: galvanized steel wire cable for suspension bridges; phosphor-bronze and copper wire rope; transmission and standing rope; galvanized wire seizing; hoisting rope; tiller rope; switch rope; copper, iron and tinned sash cord wire; clothes-lines and picture-cords; galvanized iron wire rope for ships' rigging; galvanized crucible cast-steel wire rope for yachts' rigging.

The rapid introduction of cable railways has created another demand for wire rope.

Wire Nails.—The manufacture of wire nails is another branch of business conducted by the company. The wire nail, as an article of manufacture, was scarcely known in this country ten years ago. Since that time it has come into general use, and it is estimated upon good authority that more wire nails are used to-day than cut nails. The variety is very large, running from three-sixteenths of an inch, made from No. 22 iron, to a length of fourteen inches, made from No. 000 wire.

It is a little remarkable that the introduction of two articles of manufacture—barbed wire and wire nails—should within the last fifteen years have created a new demand for wire, amounting to at least two hundred and seventy-five thousand tons per annum, which has been made possible by the use of Bessemer steel.

While the process of drawing wire is, in principle, the same as practiced fifty years ago, many improvements have been made leading to a largely increased relative product. Great advances have been made in certain of the mechanical processes, particularly in the rolling of wire rods. In 1846 the first rolling-mill at Quinsigamond produced about five tons of No. 4 rods in ten hours; at the present time the output is from forty to fifty tons in the same time.

The demand for wire and the purposes for which it is used have largely increased, as indicated by the present output of two hundred and forty-five tons daily, and the manufacture of four hundred and eighteen different kinds of wire.

The increase in the business of the corporation has been most rapid since the introduction of barbed wire. In 1875 the number of hands employed was seven hundred; in 1880 two thousand one hundred, and at the present time, 1889, there are three thousand names on the pay-roll of the company, for the most part heads of families, supporting directly not less than thirteen thousand persons, and indirectly, a much larger number.

Of the operatives, one thousand are Irish; nine hundred Swedes; five hundred Americans; two hundred and thirty-six Armenians; forty-five Germans; other nationalities, three hundred and nineteen.

The buildings of the corporation cover twenty-five acres of ground, and the machinery is driven by engines of seven thousand two hundred horse-power. The present officers of the corporation are: Philip L. Moen, president and treasurer; Charles F. Washburn, vice-president and secretary; Philip W. Moen, assistant treasurer and general superintendent; Charles G. Washburn, assistant secretary and counsel. The above, with George T. Dewey, Esq., constitute the board of directors.

The Worcester Wire Company, William E. Rice, president and treasurer, is located on the Old South Worcester privilege, utilized for manufacturing purposes from the earliest times. Here is manufactured a variety of wire, including tedder, rake teeth, wire for hay bales, and barbed fencing, bridge rope and general wire; bottling, baling wire; tinned mattress, tinned broom wire, harvesting wire on spools; wire for the manufacture of screws, bolts, rivets, nails, buckles, staples, rings, hooks and eyes, pin, hair-pin, reed, harness, heddle, bonnet, brush, broom, hat, clock and umbrella wire; also telegraph and telephone wire.

Wire-working as an industry in Worcester was contemporaneous with wire-making.

In April, 1831, Jabez Bigelow manufactured, in Rutland, "wire sieves, such as meal sieves, sand riddles, etc., also manufactures all kinds of safes for meat and provisions."

In 1834 he was located at the Stone building, Front Street, on the canal, where he manufactured "meat, milk, cheese and provision safes, wire sieves, grain, coal, sand, sugar and bakers' riddles. Fire fenders, sand screens, hatters' hurls, dusters for paper-mills, cellar and window guards, netting, wire lace, bird cages, plate covers and brass screens."

In the following year Mr. Bigelow advertised for two girls who could take a loom to their dwelling.

In 1845, Mr. Samuel Ayres began to weave wire for Mr. Bigelow in a shop in Norwich Street. Mr. Bigelow then had three looms—one large and two small ones—and the business employed in all six hands, among whom were Mr. Bigelow's sons.

The business of wire-working was subsequently conducted by several firms, and finally consolidated in the National Manufacturing Company, of which Mr. Jonah H. Bigelow, a son of Jabez Bigelow, is president. This company has conducted a prosperous business for many years, manufacturing a very large variety of wire goods.

[1] "Pocket Hand-Book of Copper and Iron Wire," published by W. A. M. Manufacturing Company, 1888.

The business now conducted by the Wire Goods Company was commenced by Charles G. Washburn in the fall of 1880, on the top floor of the building then and now occupied by C. H. Hutchins & Company, in Allen's Court. The articles manufactured were wire goods for cotton and woolen machinery.

September 12, 1882, it was incorporated under the name of The Wire Goods Company, and was continued for a time in Allen Court, but was subsequently moved into the brick factory in Union Street, the present situation. Meantime, the business has very much enlarged, employing at the present time one hundred and twenty hands. In 1888 the business of the Ayres Manufacturing Company was purchased and merged in that of the Wire Goods Company. Among the articles manufactured are bright iron and brass gimlet-pointed wire goods of all kinds. Belt hooks, hitching rings, hand-rail screws, hammock hooks, double-pointed tacks, a large variety of wire goods and a number of patented specialties; in fact, "everything in wire." Mr. A. W. Parmelee is president and treasurer of the company.

Hamblin & Russell, in Front Street, are also engaged in the manufacture of a variety of wire goods similar to those made by the National Manufacturing Company.

Henry E. Dean, Austin St., manufactures a special line of general hardware and house goods, elevator and window guards, also all kinds of steel wire brushes.

Another use to which wire is put in Worcester is the manufacture of rivets and burrs, which is conducted by Reed & Prince, 42 Gardner Street, in the basement of the pistol factory. This industry was established in 1886.

It would be difficult to enumerate the variety of articles and machinery, manufactured in Worcester, into which wire enters in one form or another.

Copperas. — An interesting illustration of the utilization of waste products is found in the manufacture of sulphate of iron or green vitriol—commonly known as copperas, and popularly, but erroneously, supposed to be a salt of copper—from the waste sulphuric acid used in cleaning wire. This waste acid, heavily charged as it is with iron, is taken to the works of W. E. Cutter & Co., where, after being evaporated in lead-lined tanks in which iron in the form of waste wire has been placed to further neutralize the acid, is drawn off into large cooling-tanks, and the copperas is deposited in green crystals upon sticks suspended in the liquid. Copperas is used in dyeing as a disinfectant, and in the manufacture of ink, and largely in the manufacture of Venetian red, also made by W. E. Cutter & Co. 7,000,000 pounds of copperas are manufactured by this company annually, representing about 700 short tons of metallic iron; about one-third of the copperas is converted into Venetian red, of which the annual product is 2000 tons. This is an oxide of iron paint, and is very extensively used.

Copperas can also be obtained by the oxidation of iron pyrites—sulphate of iron. In 1830 a bed of iron pyrites was discovered in Hubbardston, and Mr. Bennett, of that place, with Messrs. John Green, Benjamin F. Heywood and James Green, of Worcester, formed a company for the manufacture of copperas, and began operations; but the enterprise did not prove successful. In December, 1828, the canal boat "Worcester," Captain Green, among other things, brought one ton of copperas from Providence.

CHAPTER VI.

MANUFACTURING AND MECHANICAL INDUSTRIES.

Carriages and Cars — Wood-working Machinery — Musical Instruments — Envelopes.

Carriages and Cars.—The business of carriage-making was conducted in Worcester at a very early day. Curtis & Goddard were in business in 1808.

In 1822 Osgood Bradley came to Worcester, and started the stage and carriage business in a small shop in the rear of what is now Parker Block in Main Street, and the same year moved into what is now known as Atchison's carriage-shop in School Street, where he manufactured and kept on hand mail-coaches, chaises, gigs, wagons, sleighs, cutters, etc. Associated with Mr. Bradley was John Manning, harness-maker, who afterwards, in 1825, went into business with Edward M. Burr, in the manufacture to order of coaches, chaises, saddles and harness, opposite Stiles & Butman's store, a few rods north of the brick hotel.

Osgood Bradley & Co. continued in the manufacture of coaches, chaises and harnesses in School Street, near Captain Thomas' coffee-house, and were succeeded by Solon Fay, September 2, 1829.

Albert Tolman was born in Lincoln, Mass., and came from Concord to Worcester in 1833. At this time, it must be remembered, manufacturing in Worcester was in a very primitive condition; the shops were all very small, and the proprietor, with one or two workmen and an apprentice, usually did the work.

In 1833, Mr. Tolman formed a co-partnership with Mr. Samuel L. Hunstable, and advertised to do chaise and harness-making in the yard of the Central Hotel. At this time a Mr. Goddard had a harness shop north of the Bay State House, near where the Waldo Block now is. Benjamin Goddard was a carriage maker, and had a shop on the corner of Waldo and Exchange Streets, where Walker's ice office now is.

A Mr. William Leggett was at that time an old harness-maker here, and was afterwards one of the first conductors on the Nashua Railroad. The firm of Tolman & Hunstable continued until 1837, when the firm

of A. Tolman & Co., was formed, composed of A. Tolman and G. W. Russell, which continued forty years. Their work for many years was the manufacture of first-class family carriages, which they sent all over the world, some of them going to California, and even to Africa and Australia. Mr. Tolman once built a carriage for Mrs. Governor Duncan, of Ohio, before the days of railroad communication; it was shipped to New Orleans, and from there went up the Ohio River to its destination. Now hundreds of carriages come from Ohio to the East by rail.

Meantime Mr. Bradley had again gone into business, and in 1838, Osgood Bradley sold out his business to Rice, Breck & Brown, and prior to 1842, Bradley & Rice engaged in the manufacture of railroad cars, near the Western depot. This factory, which was one hundred and thirty feet by forty feet, was destroyed by fire, May 12, 1842. Mr. Bradley resumed business alone in 1849, and in 1850 had in his employ about one hundred men. His work was done in half a dozen buildings scattered over two and a half acres of ground, and at this time he had in process of construction from sixteen to eighteen passenger cars at an average price of three thousand dollars, besides a large number of freight cars.

Mr. Bradley continued in business alone until January 1, 1883, when he took into partnership his sons, Henry O. and Osgood Bradley, Jr., the firm being Osgood Bradley & Sons. Mr. Bradley remained in the firm until his death, in 1884, the firm-name continued and his sons carrying on the business.

Mr. Bradley built the first railroad cars in this country at his shop in School Street. He built four cars for the Boston & Worcester Railroad, one of which was drawn to Boston over the old turnpike road by four horses.

In 1847 Abraham Flagg, at his shop, 22 Exchange Street, manufactured I. Woodcock's patent "Worcesteree," a two-wheeled vehicle. Woodcock, Jones & Co. also manufactured them.

In 1851 the carriage business in Worcester supported about fifty families. The largest factory was that of Tolman & Russell; it embraced some half-dozen buildings and gave employment to twenty-five hands. Most of their carriages were of the more expensive kind. At this time they were finishing three, one for the Adams House, Boston; one for a New Bedford merchant, and one for Mr. White, of Worcester, "the attentive and obliging hackman, whom everybody knows and everybody employs." Besides these heavier carriages, Tolman & Russell manufactured a great many lighter vehicles of various patterns and prices, such as chaises, phaetons, rockaways and buggies. It is said that this firm at one time refused to take a large contract from the Government for the supply of army wagons for the use of the army during the Mexican War, solely on the ground that they believed the war to be unjust and did not wish to participate in the profits of such injustice.

The average number of vehicles manufactured by Tolman & Russell at this time was about one hundred per year.

The establishment of Breck & Wilder was situated in School Street, employing somewhat fewer hands than Tolman & Russell. Their shop occupied the site formerly occupied by Osgood Bradley, and their business was confined especially to omnibuses and stage-coaches. They built some of the largest omnibuses running between Boston and the adjacent towns, and had, in April, 1851, just finished an omnibus of immense proportions, named the "Jared Sparks," intended to run on the line between Cambridge and Boston.

George W. Wilder built a new light carriage known as the "York wagon." William C. Whiting's carriage factory, in Mechanic Street, employed ten hands on light carriages of all descriptions.

More recently, Tolman & Russell have confined themselves almost entirely to the manufacture of hearses, which find a market in all parts of the United States.

Mr. Tolman retired from the firm in 1879. The business is now conducted by H. J. & J. E. Russell.

Under the old apprentice system in this business, boys were taken from fifteen to twenty-one years of age, and were paid from thirty to fifty dollars a year and their board. They bought their own clothes, and the last year of their apprenticeship were paid seventy-five dollars, which included a "freedom suit."

About 1830 the working day averaged from twelve to thirteen hours, and all the work was hand-work, down to the rivets and bolts. The average wages of a good workman, $1.25 per day.

As late as 1866 a good many carriages were made by O. Blood & Sons, Tolman & Russell and Geo. T. Atchison, but most of the carriages used in this city and county were bought in Boston.

The best carriages sold to-day in Worcester are made in Merrimac and Amesbury, Mass. Cheaper carriages come from the western part of New York and the Western States. These are kept in stock by the different carriage depositaries, and probably a thousand sold yearly to supply the demand in the city and county.

George C. Dewhurst who established the first regular depositary in Worcester, manufactures sleighs. The business of Geo. T. Atchison is largely in the manufacture of water-carts.

WOOD-WORKING MACHINERY.—The automatic wood-planing machine was invented by William Woodworth in 1828.

Previous to 1836 the manufacture of wood-working machinery was not carried on as a separate industry in any part of the United States. In that year the firm of J. A. Fay & Co., composed of J. A. Fay and Edward Josslyn, commenced the business in Keene, N. H., and a few years later united with the firm of C. B. Rogers & Co., at Norwich, Conn.

In April, 1839, Thomas E. Daniels was located at Court Mills, manufacturing his patent planing-machines, "which are useful in squaring out timber for machinery, planing floor and other boards, door, bed-stead and table stuff, also for hollowing circles for water-wheel roundings and drum locks; he also builds machines for matching boards, grooving floor plank, and under floor plank, where it is desirable to put mortar between floors in factories to prevent fire; recommended by Davis & Howe; Ruggles, Nourse & Mason; White & Boyden; Henry Goulding & Co.; Horatio Phelps." He sold out his business to Deacon Richard Ball and Thomas Rice, who were succeeded by Ball & Ballard.

In 1843, Goddard, Rice & Co., put in the first planing-machine that went by power in Worcester County. In October, 1846, Arad Woodworth, New Worcester, showed a machine for planing window blind shades; and in 1847, Charles Price, successor to Price & Hartwell, was engaged in building planing-machines at No. 2 Central Street.

In 1849 Howe, Cheney & Co., at Court Mills, had made arrangements to build the Daniels Planing, Machine, to plane all wood from eight to ten inches wide, and from four to fifty feet in length.

At the Mechanics' Exhibition in 1851, Ephraim C. Tainter exhibited a Daniels Planer embodying many improvements. His factory was at the Junction shop, and he was soon after joined by Mr. Gardner Childs, who, in 1853, sold his interest to the Keene and Norwich companies already referred to, and the business was conducted as a branch under the name of J. A. Fay & Co., who also manufactured plows, power and foot mortising machinery, tenoning and sash-moulding and matching-machines. The machines of their manufacture became known throughout this country and in Europe. In December, 1858, they were building a fifty-foot planer and other machinery for the Don Pedro Railroad in Brazil.

In 1858, and prior to that time, Ball & Williams (Richard Ball and Warren Williams), successors to Ball & Ballard, were engaged in School Street, in the manufacture of planing-machines for wood-working and of improved sash and moulding-machines. They had just sent an improved Woodworth planer to R. Hoe & Co., of New York. Warren Williams retired in 1865. Mr. Ball, with his son-in-law, built the factory in Salisbury Street, now occupied by Witherby, Rugg & Richardson.

In 1859 J. A. Fay & Co. occupied one hundred feet of the second floor of Col. Estabrook's shop at the Junction, and employed thirty hands in making wood-working machinery, and had then recently sent a saw-mill to Rio Janeiro.

In 1859 Mr. Fay died, but the business was carried on by his widow and the remaining partners.

In 1864 they opened a warehouse at 107 Liberty Street, New York, for the sale of their products, and were the pioneers there in this line of business.

In 1877 William B. McIver and his brother, J. C., purchased the tools, stock and good-will of the old firm and continued the business under the name of McIver Bros. & Co. They engaged in the general manufacture of wood-working machinery on a more extensive scale than had been done in the former companies. McIver Bros. & Co. now occupy the shop below the Junction, built by Wood, Light & Co., and in addition to their other business are largely engaged in the manufacture of coffee machinery for Central America and other coffee-growing countries.

Witherby, Rugg & Richardson began business in 1864, in the Armsby building, with twenty men, and employ at this time, at their location in Grove Street, seventy-five men. They make a large variety of wood-working machinery, which goes to all parts of the country.

Musical Instruments.—The principle of producing music by the vibratory motion of a reed is most simply illustrated in the jewsharp, and the development of this principle through the successive stages of harmonium, accordion, elbow melodeon, with foot-pedal for working the wind-chest, has resulted finally in the cabinet organ of to-day. This development has taken place within the present century.

The business of organ-building has been conducted in Worcester for more than forty years. In 1847 Mr. N. B. Jewett was engaged here in making melodeons, and in 1849 Mr. Milton M. Morse, who came from Concord, N. H., manufactured seraphines, melodeons and eolians for church and parlor use. The first melodeon was copied from the accordion. Mr. Abraham Prescott, of Concord, N. H., manufacturer of bass viols and violoncellos, made an accordion for Mr. James A. Bazen, of Canton, who thereupon had an enlarged one made by Mr. Morse, then in his employ.

In 1847 the firm of Farley, Pierson & Co., consisting of John A. Farley, John G. Pierson and M. M. Morse, began business, which was conducted in the old Burnside Building, in Main Street. The first cases for this company were made by Partridge & Taber. The first melodeon made was a four-octave melodeon, held in the lap, with two rows of keys, sharps and flats. The round keys were pushed in like the keys upon the small concertinas which are made now. The sharp keys had black rings painted on the ivory. The melodeon was held in the lap, and, while the keys were operated by the hands, the elbows worked the bellows. These instruments were greatly enlarged until they were put upon legs and called seraphines, the bellows still being worked with the elbows.

The cabinet organ is the melodeon on a large scale. Modern instruments have the exhaust bellows, while the old instruments have the pressure bellows. At the beginning this company had six hands; Mr. Morse did the tuning, Mr. Farley made the reeds, and Mr. Pierson the wood-work. Subsequently, in 1852, Pierson & Loring succeeded to the business.

One of the first melodeon-tops made by this company was twenty-two inches long, twelve inches wide, with four octaves. The bellows were made in two folds; when the wind went out of one fold it came in and filled the other. At the last New England Fair one of these instruments, made forty years ago, was shown and operated.

Taylor & Farley were manufacturing melodeons in 1855, and in 1862 harmoniums for parlors, churches and schools. In 1865 their factory in Hermon Street was erected.

In 1856, the Steam Music Company was formed to manufacture the calliope, an instrument designed to produce music by steam—the invention of a Mr. J. C. Stoddard.

In June, 1858, E. Harrington & Co., at the Junction shop, manufactured melodeon reeds, succeeded by A. Davis & Co.

In 1859 the American Steam Music Company was located in Estabrook's building and employed twelve hands in the manufacture of calliopes and terpsichoreans.

"The latter is an entirely new thing, and this company has just completed the first one as an experiment. Its notes are agreeable and pleasant to the ear. The music for these instruments is arranged by M. Arbuckle, leader of Fisk's Cornet Band, on the same floor."

In 1860 the calliope was introduced into England.

The Loring & Blake Organ Company, located in Union Street, was incorporated in 1868. Messrs. Loring & Blake, the founders, were at one time with Taylor & Farley Organ Company, and first engaged in business in Southbridge Street, in French's building, and afterwards moved to the building in Hammond Street, which was later burned down and never rebuilt. From there they moved to the Adams Block, between Main and Southbridge Streets, the site of the new Post-Office, and also hired some rooms of E. S. Stone, their mill-work being done in Cypress Street. They now occupy the large five-story brick factory in Union Street.

The lumber used by this company comes comparatively dry, but they have two large dry-houses with a capacity of fifty thousand feet. From the dry-houses the lumber passes to the mill-room, is cut up into the proper sizes and glued; it then goes through the scraping and smoothing-machines. This company uses a machine for carving which does many parts of the work formerly done by hand, although some of the work can still be done cheaper by hand than by machinery. From the mill-room, with its multiplicity of saws and wood-working machinery the work goes to the case-room, adjoining which is the tuning-room; here the tuner has a set of reeds pitched, from which the reeds are fitted for the organ. Formerly the reeds were left perfectly straight, but now are bent somewhat, which is supposed to give a superior tone. This is a return to the earlier practice, as the reeds of the first melodeons were made in this way. This company uses a patent stop motion of its own on its organs. The work of the factory is all divided into departments; the reeds and reed-boards are purchased outside, and put into cases in the factory. The bellows stock is also purchased.

The Taber Organ Company in Hermon Street—N. H. Ingraham, president, William B. Baker, treasurer, —was established in 1872 as the Worcester Organ Company. Shortly afterwards, Mr. William B. Taber, who had been with Loring & Blake Organ Company, bought the business, and later, in 1877, the Taber Organ Company was formed, starting with fifteen hands. The company now employ forty. Their product goes all over the world. The changes and improvements made in organ-building, have, for the most part, been in the styles of cases, in couplers and tremolos—the change in the latter being from the valve to the fan tremolo.

The company now known as the Worcester Organ Company is a continuation of the business formerly conducted by E. P. Carpenter, and has now commenced the manufacture of pianos. The manufacture of organ-reeds, while closely connected with the manufacture of organs, is a distinct business. Previous to 1846 reeds were made by hand. About that time Jeremiah Carhart, of New York, devised machinery for making the organ-reed to be used with exhaust bellows, which he had invented and patented. Redding & Harrington, of Worcester, also devised a machine for making the reeds. Mr. A. H. Hammond bought a one-third interest in this business and, finally, all of it. The Hammond shop, in May Street, now does a large domestic and foreign business, and employs two hundred hands.

George W. Ingalls & Co., Hermon Street, manufacture organ-reeds and reed-boards, Parker tremolos and octave couplers and fan tremolos.

The Munroe Organ Reed Company was established in 1860. It was incorporated in 1869 with a capital of $13,300, and employed ten men. In 1875 the capital was increased to $60,000, and in 1878 they added to the manufacture of reeds that of automatic instruments; since then they have employed something like 250 men at one time. In 1879 they moved to their present location in Union Street, where they have the most complete facilities and most ingenious machinery for the prosecution of their business. They use from 150,000 to 200,000 pounds of sheet brass per year, from which the rough frame-work of the reed is punched; it is then planed and milled; the reed grooved and the tongue securely fastened in place by machinery; another machine letters the reeds, of which 15,000 are manufactured daily. The reed-boards are made of the best Michigan quartered pine. The places for the reeds are cut in the reed-boards by machinery. The product of this company goes all over the world. The export business amounts to $100,000 per year.

ENVELOPES.—Envelopes were first used in England between 1830 and 1839, but only in a very limited way, as the use of an envelope called for double postage, the law then being that postage should be charged for the number of pieces of paper. This explains the custom, then prevailing, of folding the letter-sheet to make it answer the purpose of an envelope.

The Penny Post was established in 1840 by Sir Rowland Hill, and a demand for envelopes was at once created.

Up to this time, and for several years after, all the envelopes used were cut by hand; each stationer had blank patterns of several sizes of envelopes, and with the aid of a sharp penknife cut the blanks three or four at a time. On rainy days these blanks were folded and stuck together in the form of envelopes. There are to-day, in this country, stationers in business who in early life made in this way all the envelopes sold in their stores.

The first machine for making envelopes was invented in 1845 by Edwin Hill, a brother of Sir Rowland Hill, the father of penny postage.

Worcester has taken a foremost place in the development of the manufacture of machine-made envelopes. The third United States patent on a machine for making envelopes was issued to Dr. Russell L. Hawes, of this city, in 1853; the two preceding patents were upon machines of no practical value, so that it may fairly be said that the first successful machine in the United States for making envelopes was invented and patented by a Worcester man and built in the city of Worcester.

Dr. Hawes was then agent for Goddard & Rice, and saw in New York some hand-made envelopes, very likely made by a Pole named Karcheski, who is said to have made the first hand-made envelopes in this country.

Dr. Hawes thought he could make envelopes by machinery, and, returning to Worcester, built a machine in the shop of Goddard & Rice, which was subsequently patented. The blank for the envelope was first cut out by a die, then the sealing flap was gummed, the envelope blanks being spread out, one overlapping the other, and the gum applied with an ordinary brush. When the gum was dry the blanks were introduced into the folding-machine, which was a self-feeder, and in this Dr. Hawes applied the principle which is used on every successful envelope-machine in existence.

Up to this time all attempts at making envelopes by machinery had dealt only with the folding of the envelope, the blanks being fed to the machine by hand. Dr. Hawes went a step farther, and attached a feeding device to his folding-machine.

The blanks, having been cut and gummed on one edge, were fed to the machine in bunches of five hundred; gum was applied to the under side of the picker, which descended on top of the pile of blanks; the top blank adhered to the picker and by it was lifted to the carriage, which conveyed it under the plunger by which the blank was forced into the folding-box. Small wings then folded over the flaps of the envelope and the gum by which the blank had been elevated to the carriage now performed a second office, that is, sticking the envelope together. The envelopes thus made by Dr. Hawes were sold to Jonathan Grout.

It required the services of one girl to attend the machine, while it took half the time of another girl to spread the gum on the sealing-flaps, so that three girls could produce a finished product of about twenty-five thousand envelopes in ten hours.

Thinking the machine had reached its maximum product, Dr. Hawes, who meantime had moved to the factory of T. K. Earle Manufacturing Company in Grafton Street, sold out, in 1857, to Hartshorn & Trumbull (Charles W. and George F. Hartshorn and Joseph Trumbull), who were succeeded in 1861 by Trumbull, Waters & Co. (Joseph Trumbull and Lucius Waters). In 1866 Hill, Devoe & Co. succeeded to the business. Mr. W. H. Hill is the present proprietor.

The principal improvements made in machinery have been in increasing the capacity, and with that, improving the quality of the manufacture, as the envelopes made on the old machines would not now be considered saleable.

At the present time one girl attending two machines can produce seventy thousand envelopes in ten hours. Mr. Hill owns the patent on his machines, they having been assigned to him by the inventor, in his employ, Mr. Abraham A. Rhentan, who has done much to contribute to improvements in envelope machinery.

The Reay machine is also used in this establishment. This is the invention of George H. Reay, of New York, and was patented in 1863. From one hundred and twenty-five to one hundred and fifty hands are employed in this factory.

The next Worcester man to make valuable improvements in envelope machinery was Mr. James G. Arnold, who, in 1858, devised a machine cutting the material for an envelope from a roll of paper, and also gummed and folded the envelope complete in one operation. He introduced into this machine the drying chain. By this invention, the gum, which theretofore had been applied to the sealing-flap with a brush, was applied to the envelope by the machine, and after the machine had folded the envelopes they were deposited in this drying chain, or endless belt with fingers, the envelopes being kept separate while the gum on the envelopes was drying.

This principle is a feature in nearly all envelope machinery of the present day, excepting the machines invented by D. W. & H. D. Swift.

While Mr. Arnold's machine was not a practical success, it had in it the foundation principles upon which the success of the self-gumming envelope-machine depends.

In 1864 G. Henry Whitcomb came into possession of the Arnold machines, and began the business of envelope-making in a small building in School Street, where the engine-house now stands. In 1865 he removed to the north corner of Main and Walnut Streets, where he remained till January, 1866, when he removed to Bigelow Court; he was then making one hundred thousand envelopes per day. This factory was the first building in the United States used exclusively for the manufacture of envelopes.

At that time Mr. David Whitcomb sold out his interest in the hardware store of Calvin Foster, and joined his son, the firm being G. Henry Whitcomb & Co

In 1873 the business was moved into the present factory in Salisbury Street, additions to which were built in 1878 and in 1886. In 1884 the firm became a corporation, known as the Whitcomb Envelope Company. The machines used have been built on their own premises, and the patents upon them are owned by the company. The machines are the invention of Messrs. D. W. & H. D. Swift, who, in 1871, built one upon an entirely new principle, capable of making thirty-five thousand envelopes in ten hours.

In 1876 the Messrs. Swift invented their first self-gumming machine. A girl could run two of these machines, making seventy thousand envelopes in ten hours. The product was automatically registered, these being the only machines in the world with a clock attachment.

Besides the invention of four distinct envelope-machines, the Messrs. Swift have patented an automatic printing-press, for printing envelopes. The blanks are fed to the machines in three or four thousand lots, picked up singly by the air-feed, and carried into the press, where they receive the impression. They are then discharged on the opposite side of the machine and piled up, ready for the envelope folding-machine.

The construction of this press is very simple. It has a stop-motion attachment, and is so delicately adjusted that a single hair stretched across the attachment will spring the let-off motion and the press will stop. Seven presses, each capable of producing 30,000 impressions in ten hours, can be run by a man and girl, making a total of 200,000 impressions with only two operatives. The great efficiency of this machine will be appreciated when it is considered that 11,000 to 12,000 impressions is a large day's work for an operative on an ordinary job press.

One hundred and fifty hands are employed in the Whitcomb Envelope Factory. Their daily product is one million envelopes, with a capacity of double that amount.

To illustrate the efficiency of the Swift machine, owned by the Whitcomb Envelope Company, it can be said that Herman Schott, the largest envelope-maker in Germany; Alexander Pirie & Son, Aberdeen, Scotland, the largest envelope-makers in the world; and Fenner & Appleton, of London, one of the largest envelope-makers in England, several years ago equipped their factories with the Swift machine.

The Logan, Swift & Brigham Envelope Company was incorporated February 1, 1884. Messrs. Logan, Swift & Brigham were for a long time associated with the Whitcomb Envelope Company. Their machinery is the invention of Messrs. D. W. & H. D. Swift, who have been mentioned in connection with the Whitcomb Company. Logan, Swift & Brigham employ one hundred hands.

Upon reviewing the history of these three companies, it is apparent that Worcester has been most prominently identified with the inception and development of machine-made envelopes. The most important contributions that have been made to this art have come from Dr. Hawes, Mr. Arnold, Mr. Rheutan and the Messrs. Swift, who have taken out upwards of twenty patents. The production of a single operative has been increased from less than 10,000 staple envelopes per day to 70,000.

In 1864 six males and sixty females were employed in the envelope business in Worcester. The capital invested was $30,000.

To-day three millions of staple envelopes are made daily, which is between one-fourth and one-third of the entire product of the United States, and constant employment is given to four hundred operatives.

CHAPTER VII.

WORCESTER — *Continued.*

MANUFACTURING AND MECHANICAL INDUSTRIES.

Fire-Arms—Iron and Steel Business—Screws—Steam-Engines—Boilers.

FIRE-ARMS.—Harding Slocomb, December 6, 1820, notifies his friends that he has established his business as gunsmith in Worcester, opposite Jeremiah Robinson's drug store, a few rods south of the Court-House, where he manufactures twist and straight rifles, fowling-pieces, and has musket-guns and pistol-flints for sale. These fire-arms were, of course, all made with the old flint-lock.

At this time Asa Waters (2d) had a gun-factory in Millbury, where he made government arms. Ware & Wheelock, at the top of Front Street, opposite the City Hall, in 1825, manufactured guns, and in 1833 Joseph S. Ware and John R. Morse were established in Main Street, where guns, rifles, fowling pieces and muskets were made to order.

Ethan Allen is identified with this business from an early day up to the time of his death, and contributed very largely to improvements in methods and machinery. Mr. Allen was born in Bellingham, Mass., in 1810, where he received a common-school education,

His first mechanical employment was in a machine-shop in the town of Franklin.

In 1831 he was engaged in manufacturing shoe cutlery in Milford, and in 1832 moved to what was then known as New England Village, in the town of Grafton, where he commenced the manufacture of the Lambert Cane gun, in connection with shoe cutlery. This was the beginning of the fire-arms business which he prosecuted so successfully thereafter.

In 1833 he built a shop, which he occupied for some time for the manufacture of fire-arms and shoe-kit; this is still standing and used for manufacturing purposes. In 1834 Mr. Allen manufactured the saw-handle target rifle-pistol, and it is said that in 1835 he took one of these pistols to New York, and showed it to a Mr. Speis, who was engaged in selling fire-arms, and asked if there would be any demand for such an article. Mr. Speis looked at the pistol, and said: "Do you make these?" Mr. Allen replied "Yes." "What is your price?" Mr. Allen named it. "Why don't you ask twice as much?" was the reply; "I will take all you can make."

Thus encouraged, Mr. Allen returned to New England Village and began to make the pistols. Soon after he invented the self-cocking revolver, which was widely known at that period, and subsequently during the Mexican War and the California gold discoveries, during which time the business was most prosperous and profitable. As a gold-miner, Mark Twain "Roughing It," gives an amusing description of his experience with this self-cocking revolver, and the degree of skill in marksmanship which he had acquired by constant practice. "There was," he says, "no safe place in all the region round about." On one occasion he brought down a cow fifty yards to the left of the target, when an interested spectator persuaded him to purchase the carcass.

About 1837 Mr. Allen took into partnership his brother-in-law, Mr. Charles Thurber, who remained in business with him until 1856, when the firm was dissolved, Mr. Thurber retiring.

Early in the fifties he associated with himself another brother-in-law, Mr. T. P. Wheelock, who died in 1863, the firm being Allen & Wheelock. In 1842 the company moved to Norwich, Conn., where they carried on the manufacture of fire-arms. In 1847 they came to Worcester and located in Merrifield's building, where they remained until the great fire of 1854. Immediately after, they erected a shop at the Junction, now occupied by the L. D. Thayer Manufacturing Company and the Worcester Elevator Company, where the business was for some years prosecuted by them and their successors.

The removal from Norwich was the practical beginning of the fire-arms business in Worcester; since which time it has been a most important industry. Previous to that date there was nothing that could properly be called a manufactory; there were a few small shops, but nothing more.

In 1865, subsequent to the death of Mr. Wheelock, Mr. Allen took into partnership his two sons-in-law, Messrs. S. Forehand and H. C. Wadsworth, under the name of Ethan Allen & Company, and so continued until the death of Mr. Allen, January, 1871; after that, the business was continued by the surviving partners, under the firm name of Forehand & Wadsworth. Since 1883 the business has been prosecuted by Mr. Forehand alone, and since 1876 has been located in the Stone shop at the Junction, known as the Old Tainter Mill.

Mr. Allen was a mechanic and inventor of superior capacity. He invented a doubled-barreled breech-loading sporting gun, and was probably the first to use steel shells in connection with such an arm; these shells can be re-loaded indefinitely. He was the pioneer, in this country, in the manufacture of double barreled shot guns and fowling pieces.

Between 1855 and 1858 a change was made from the system of muzzle-loading to breech-loading fire-arms, although the breech-loading system had been adopted in Europe before that date, and, at the same time, the change was made from loose to fixed ammunition.

Allen & Wheelock were among the first to adopt the breech-loading system and to introduce the metallic cartridge.

Neither in this country nor in Europe had metallic cartridges been made except by hand—a slow and most tedious process. Mr. Allen recognized the necessity of making the metallic cartridges by machinery, and invented and patented the first set of machinery that was ever built for that purpose. The heading-machine, which is used by every manufacturer of metallic cartridges in the world, was his invention, and has stood the test of litigation. Prior to this, no one, so far as is known, had conceived of any process of forming the head except by spinning it up in a lathe.

At the Centennial Exhibition in 1876 the Government exhibited a set of this machinery, and there was nothing in the Mechanical Exhibition which attracted more attention. The whole process, from beginning to end, was the product of Mr. Allen's brain.

Probably no fire-arms manufacturer in the country made so great a variety of arms as he: from the whale bomb-lance to the cheap Fourth of July pistol, and every variety of fowling-piece.

Formerly all work was done with the file, cold chisel and anvil, but methods have greatly improved, until now there is no finer work done than what is popularly spoken of as "gun work." The parts are all interchangeable and made with the greatest nicety.

Charles Thurber, at one time associated with Mr. Allen, was a successful teacher in Worcester, and is credited with having invented the first type-writing machine, which is said to be still in existence.

Franklin Wesson, after his return from California,

1859, began to manufacture fire-arms in Merrifield's building in Exchange Street. The first arm he manufactured was a single-shot breech-loading pocket pistol using a cartridge.

Mr. Wesson during the war manufactured twenty thousand stand of arms for the Government. At present he manufactures long range, short range, sporting rifles and pocket pistols.

Mr. Frank Copeland, 17 Hermon Street, established a manufactory for fire-arms in 1863; he was formerly in the employ of Allen & Wheelock, at their old shop at the Junction. He first manufactured revolvers, and in 1876 devised a single-shot breech-loading sporting gun, called "The Champion."

Mr. Copeland's second gun is a single-barreled sporting gun, called the "F. Copeland Gun," which is more strongly constructed, better in action and capable of standing heavier charges, and altogether more durable.

Harrington & Richardson Arms Company.—This business was established in 1871 by F. Wesson and G. H. Harrington, under the firm-name of Wesson & Harrington, for the purpose of manufacturing a shell-ejecting revolver, invented and patented by Mr. Harrington, and the business was located at 18 Manchester Street, in the building owned and used by Mr. Wesson as a rifle factory, a business in which he had been engaged for many years. This firm continued until 1874, when Mr. Wesson's interest was purchased by Mr. Harrington, who soon afterward formed a co-partnership with William A. Richardson, under the firm-name of Harrington & Richardson, and the manufacture of the same style of revolver was continued. This revolver, which was the starting-point of the present business, was an improvement in convenience over any other then made, it being so constructed as to load and have the exploded shells removed by the sliding ejector, without detaching the cylinder or removing any portion of the arm; and it is believed to have been the first successful shell-ejector used on a metallic cartridge revolver. It had a large sale for a number of years. Various other styles of revolvers have been added, improvements made and patented from time to time. In the fall of 1876 the business was removed from Manchester Street to the more commodious quarters 31 Hermon Street. Here new and improved machinery and appliances were brought into operation, and have been constantly increased from year to year, and additional room occupied.

In 1880 Messrs. Harrington & Richardson became the sole licensees in the United States for the manufacture of the celebrated Anson & Deeley hammerless gun, an English invention. This was a high cost arm ranging in price from eighty-five to three hundred dollars. The manufacture of this gun was continued for about five years. In January, 1888, Harrington & Richardson dissolved their co-partnership, and reorganized as a stock company, with the following officers: Gilbert H. Harrington, president, William A. Richardson, treasurer; George F. Brooks, secretary.

The business of the company is the manufacture of revolving fire-arms exclusively, which are produced of various styles and of different prices, from the plain, substantial, solid frame arm, from which the cylinder is removed by the withdrawal of the centre-pin upon which it revolves, to the more elaborate hinge-frame revolver, employing the automatic shell-ejecting system, by which all the exploded shells are thrown out automatically by the act of opening the arm for reloading.

All the arms manufactured by the company have a high reputation for quality, beauty of appearance and reliability. Very few persons not practically acquainted with this business have any idea of the amount and nicety of machinery and special tools and appliances required, and, where revolvers are produced in large numbers, of the care and close inspection necessary to maintain a high standard. If one would undertake to manufacture a new revolver of good quality and the average intricate construction, and were already provided with all the machinery that can be purchased of machine tool builders, adapted to this business, it would require a year to construct one small revolver, and make the tools and appliances necessary to produce the arm in quantities and of good quality.

Iver Johnson & Company, established in 1871, are located at 44 Central Street, and employ two hundred hands. Their products are air pistols, guns, revolvers and other arms; ice and roller skates.

January 30, 1856, notice is found of a new rifle invented by B. F. Joslyn, the manufacture of which was controlled by Mr. Eli Thayer. It was claimed to be superior to the Sharpe's rifle, both on account of the rapidity of its loading and the simplicity, safety and cheapness of its construction.

In March, 1859, the *Spy* said that Mr. Joslyn and Mr. Freeman, of New York, had purchased the large stone shop at South Worcester, where they expected to commence the manufacture of pistols under Joslyn's patent at an early day; and, in 1860, the War Department ordered from Mr. Joslyn one thousand of his rifles, which up to that time was the largest single order for fire-arms ever given to one contractor in the country. The Navy Department had previously ordered five hundred.

In April, 1861, they were busy day and night at the Lower Junction shop manufacturing Joslyn's breech-loading carbines for the War Department. Fort Sumter had then been fired upon and the demand for arms became pressing. All the iron-working establishments in the city were busy furnishing the Government with ordnance. Nathan Washburn was making five tons of rifle barrel iron per day for the Springfield Armory, and was under contract to furnish one hundred thousand musket barrels.

Osgood Bradley was at work on gun-carriages and forges. Wood & Light were busy making machinery for the government at Springfield Armory. November, 1861, Shepard, Lathe & Co. were under contract for Colt, the Burnside factory and Springfield Armory. Allen & Wheelock had two hundred hands at work for the government and private parties. L. W. Pond was building twenty light rifle-cannon of his invention, called the "Ellsworth Gun," at the shop of Goddard, Rice & Co. This was a "breech-loading rifle-gun, four feet long, six inches in diameter at the breech and 3½ at the muzzle, with a 1½ inch bore, carrying a chilled conical ball weighing 18 ounces, which it will throw three miles. The gun weighs, carriages and all, 450 lbs. Cost, $350."

July 11, 1862, a patent was granted to Theodore R. Timby, of Worcester, for improvements in a revolving battery-tower and improvements for discharging guns by electricity. Joslyn's breech-loading carbines were in high favor at this time with the government.

In 1862 Ball & Williams (in School Street) employed one hundred men in the manufacture of the Ballard rifle,—a cavalry rifle which they continued to make until the close of the war. This was a breech loading arm, using a .42 metallic cartridge, and the invention of Mr. Ballard, who had been a foreman for Ball & Williams.

December 29, 1862, the invention of Stevens' Platoon-gun, invented by W. X. Stevens, of Worcester, is noticed.

In April, 1863, Charles S. Coleman invents a breech-loading gun.

September 6, 1865, the Green Rifle Works was at the Junction shop.

January 15th, Ethan Allen & Co. were making from 20,000 to 50,000 cartridges per day.

Iron and Steel Business.—Nathan Washburn, at one time, worked for William A. Wheeler as a journeyman founder, and while in his employ invented a car-wheel, which he patented in 1852. In company with Mr. Converse, of his native town of Tolland, Conn., Mr. Washburn began the manufacture of these wheels in Franklin Street, next to Bradley's car-shop, and continued there until 1857, when the new building was erected near the freight depot of the Western Railroad, since occupied by Washburn Iron Company, and later by the Worcester Steel Works. The building, as designed, was to be occupied in part by Nathan Washburn as an iron-foundry for the manufacture of car-wheels; the main building was to contain machinery for re-rolling iron rails and for making locomotive tires, while the western end was to be occupied by Henry S. Washburn for a rolling-mill and a wire-factory. Meantime Mr. George W. Gill became associated with Nathan Washburn in the rail and tire business, and very likely suggested engaging in it; for he had been employed as foreman and contractor in charge of the iron work upon the cars built in Mr. Bradley's shop, where Mr. Gill must have become more or less familiar with the railroad business. Previous to the introduction of the wrought-iron rail, rails were made of wood, with flat bar-iron on the upper surface; when the rails were loosened, the ends, called "snakes' heads," were often forced up through the car-bottoms, to the great discomfort and danger of the passengers. Mr. Gill was born in West Boylston, and learned the blacksmith trade in this city.

June 1, 1858, he retired from the partnership, but continued with Mr. Washburn as manager of the business.

In 1859 this business had reached considerable proportions, employing from one hundred and seventy to one hundred and ninety hands, and turning out forty tons of iron per day.

At this time, Mr. Washburn, in company with Canadian capitalists, established a rolling-mill at Toronto for re-rolling rails for the Grand Trunk Railway; he attended to the equipment of the mill, and three large steam-hammers were made for it by Wood, Light & Company.

In 1860 there was but one establishment in New England doing railroad work of this character, and that was located at South Boston. The Washburn car-wheel was very popular, and there was a good demand for re-rolling rails and for locomotive tires. Five hundred thousand dollars capital was employed in the business, and from two hundred and twenty to two hundred and forty men with a pay-roll amounting to seven thousand dollars per month. The works extended over four acres of ground. In the foundry, one hundred and seventy-five feet by sixty feet, forty car-wheels were cast each day and eight tons of machinery. In the rolling-mill, two hundred and fifty rails weighing forty tons were rolled daily, and also four tons of tire for driving-wheels, while seven puddling furnaces produced twenty tons daily of bar or puddled iron.

The trip-hammers for working over and welding together the worn-out rails were of large size, made by Wood, Light & Company, at their shop at the Junction, by whom the first set of gun-barrel rolls were made in 1860 for Mr. Washburn; these were modeled after an English set in the armory at Springfield.

In 1864 the Washburn Iron Company was formed, with Nathan Washburn, president, George W. Gill, manager, and Edward L. Davis, treasurer.

In 1864 Mr. Washburn went to Europe, and when he returned, brought with him an equipment for a small Bessemer plant of about one ton capacity, which he partially built but never completed. This must have been one of the earliest attempts in this country to erect a plant for the manufacture of Bessemer steel, as the first steel actually made was at Wyandotte, Mich., in the fall of 1864.

In 1865, Mr. Washburn sold out his interest to his

associates and built the works in Grafton Street, now occupied by the Washburn Car Wheel Company, where he continued the business of manufacturing car wheels until about 1866, when he sold out his wheel business to the Washburn Iron Company, and engaged in the manufacture of steel tire car wheels, and later started a foundry in Hartford to be run in connection with the Worcester shop. Mr. Washburn sold out his interest the same year altogether, but the business continued under the name of the Washburn Car Wheel Company, the product being locomotive truck and tender wheels.

Mr. Washburn then went to Allston, and remained until within two years, and is now engaged at South Boston perfecting a new solid cast Bessemer wheel. After leaving Allston, his plant was leased by Jonas S. Hart & Co.; it was burned down, later re-built, and is now occupied for the manufacture of wheels by Samuel D. Nye, under the firm-name of Jonas S. Hart & Co.

Mr. Nye has been connected with this business since 1859, having been associated with Mr. Washburn at that time and was with his successors in the business until the spring of 1888, when he resigned his position as manager of the Worcester Steel business and removed to Allston.

The Washburn Iron Company continued the business of re-rolling iron rails until 1881, when the demand almost entirely ceased by reason of the general adoption of the Bessemer steel rails, which resulted in a great saving in railroad construction. Iron rails were delivered in Boston in the summer of 1868 at eighty-eight dollars per ton of two thousand two hundred and forty pounds, while steel rails were delivered in Boston, November, 1888, at thirty dollars per gross ton.

In the winter of 1881 they began the importation of steel blooms, and in the spring of 1882 began rolling steel rails. Mr. Gill died April 13, 1882, and Mr. George M. Rice then acquired an interest in the business, which was managed by the Gill estate until October, 1883, when the entire property passed into the hands of Mr. Rice and his associates, who organized the Worcester Steel Works. The work of rolling steel blooms into rails continued until the fall of 1883, when work was begun upon the Bessemer steel plant, and the first steel was made in June, 1884. Later, an open hearth furnace was put in, and during the year 1888 two new trains of rolls have been added, modern heating furnaces, etc., for the manufacture of merchant bars.

About four hundred men are employed in these works, producing two hundred and thirty tons daily, made up of rails for steam and horse railroads, blooms, billets and shapes, merchant bars and castings. For over thirty years this business has had a prominent place among the industries of Worcester, being at one time the largest single industry in the city. It has followed the complete revolution of the rail business consequent upon the introduction of Bessemer steel, and to-day stands equipped with all the modern appliances for the production of iron and steel. All this has followed from the invention of a car-wheel in 1852 by Nathan Washburn in the Wheeler foundry in Thomas Street.

Screws.—July 19, 1809, a patent was granted to Abel Stowell for cutting wood screws, but no screws appear to have been made in Worcester until 1831, when C. Read & Co. commenced the manufacture of wood screws at Northville, as has been stated in connection with the early history of the wire business. In April, 1836, mention is made of made of a machine for making wood screws, invented by C. Read & Co., "which will cut thirty gross of screws per day with one pair of dies, and one boy can attend from two to four machines, according to the length of the screw." The business is then spoken of as growing and flourishing, but the parties in interest became discouraged and the business was moved to Providence, and continued there for a time under the name of C. Read & Co., but finally came under the control of the company now and for many years known as the American Screw Company. Since that time no wood screws have been made in Worcester.

Worcester Machine Screw Company.—Mr. A. W. Gifford, who, when a boy, was apprenticed to parties in Providence, in 1853–54 engaged in making wood screws, and later was employed in Worcester by Allen & Wheelock in their fire-arms business, and by Ball & Williams in making the Ballard rifle for the Government, in 1866 received from the Worcester Mechanics' Association a testimonial for a case of milled machine screws, which were the first made for the market in the city or county, and probably in the State. The Worcester Machine Screw Company started in a very small way, with a few machines of their own manufacture, made after some of Mr. Gifford's designs. Originally, it was a co-partnership between A. W. Gifford and E. A. Bagley, but later Mr. Gifford became and has continued to be the sole proprietor. The business has grown, many changes have been made in the machinery, and important processes introduced, so that this company is to-day able to compete with any concern in the country in this line of business, in which everything depends upon accuracy and efficiency in the tools, machines and fixtures.

The machine used in the screw business prior to 1866 was what was known as the turret-head machine, used by gunsmiths, sewing-machine makers, and at the Springfield Armory. This was not well adapted to the class of work required of it. Mr. Gifford was the inventor of the machine used by himself and others which superseded it, and which has remained in use till the introduction of newer machinery. The old turret-head machine consisted of a revolving traverse spindle, with a dial for holding a series of tools. That, in turn, was succeeded by a machine in-

vented and patented by Mr. Gifford September 28, 1875, and improved December 26, 1876, in which the blanks are cut automatically to the length required for the screw and fed into the machine, which is so arranged that they are simultaneously milled, threaded and pointed.

The product of this factory now goes to all parts of the country. From eighty to one hundred hands are employed, and some four hundred tons of iron and steel used per annum; the factory is located at 75 Beacon Street, a brick building, two hundred and fifty by thirty-six, two stories high, with a basement under the main building, with a wing forty by thirty-six for office and packing room. The steam-power is furnished by a one hundred horse-power boiler, and an eighty horse-power Corliss engine. Besides his improvements and patents on screw machinery, Mr. Gifford has taken out patents on small hardware articles, such as tweezers, cutlery, etc.

McCloud, Crane & Minter, manufacturers of machine screws, are located at 57 Union Street. The business was purchased in 1872 of James H. Gray, who in 1870 had bought a patent of Bagley's. Meantime, in March, 1869, Mr. Minter started the same business and continued up to 1884, when he consolidated with McCloud & Crane, and the firm became McCloud, Crane & Minter. Their business is milled machine work, standard and machine screws, studs for steam-engines, pumps, etc., and machinists' taps, to which they have recently added finished and case-hardened nuts. Improvements have been made from time to time in the machinery, and their capacity has been increased, but the advance has been for the most part in the direction of turning out an increased quantity from a given number of machines, and in the department of thread-cutting. Beginning with twelve hands, they now employ forty-four. Their iron is purchased in the square, round and hexagon, and also in the shape of wire drawn to size.

A. A. Bedard & Co., 89 Exchange Street, are also engaged in this business.

Steam-Engines.—The mills in Worcester depended almost exclusively on water or horse-power until 1840. Mr. Wm. A. Wheeler is said to have had a steam-engine of some sort to run a fan in his foundry prior to his removal to Brookfield, and upon his return to Worcester, in 1831 or 1832, he abandoned this engine and substituted horse-power, which he used until 1840, when he put in another engine.

Howe & Goddard, at the Red Mills, had an engine of some kind in 1836.

Mr. Wheeler is credited in Bishop's "History of American Manufactures," with having the first steam-engine employed in the State west of Boston.

In 1840 Mr. Merrifield put in an engine of from four to six horse-power, opposite the location of his present office; and probably the first efficient steam-engines in Worcester were put in at this time by both Mr. Merrifield and Mr. Wheeler.

The demand for power at this time was larger than the supply, so that an engine purchased one year was discarded the next for a larger one. Between 1840 and 1850 Mr. Merrifield put in five engines. The last one, put in in 1854, is still running.

Steam-engines were not manufactured in Worcester to any extent until 1864. Mr. Wm. A. Wheeler made an engine in 1842 for Wm. T. Merrifield.

Jerome Wheelock, at one time engineer of the Washburn Iron Works in this city, commenced his business career by making and introducing the sectional ring and piston packing, patented in 1864, and afterwards extensively used in every type and make of engine. Meeting with marked success, he completed, in 1865, arrangements for its manufacture with William A. Wheeler, of Worcester. The demand soon became such that he left the Washburn Iron Company, to give his entire attention to the packing business. In the fall of 1865, or spring of 1866, he formed a partnership with Charles A. Wheeler.

This led to a considerable repair business, and that in turn led to the invention by Mr. Wheelock of several improvements in steam-engines. In the fall of 1869, the first engine embodying these improvements was built; this proved to be the beginning of a considerable business. The earlier engines of this type were constructed with a single rotary valve, which proved imperfect in many respects, but contained the germ of success. The growth of the packing business and the prospect of engine-building occasioned the removal to 178 Union Street in 1869, where the business has since been continued.

Step by step the Wheelock engine has been improved, until in 1873, at the American Exhibition in New York, the four-valve engine was introduced to the public. This employed the rotary tapered valve, suspended on hardened steel spindles—a new type of valve, which has become widely known and used. Mr. Wheelock has invented and patented numerous improvements relating to the steam-engine, such as feed-water heaters, condensers, and various details of the Wheelock engine.

The building of these specialties, together with the piston-packing and a large increase in the engine business, required successive enlargements, until the two floors of the present location were occupied, and a force of from fifty to seventy-five men employed. During the interval from 1873 to 1884 a great number of engines were built, including a large proportion of machines of five hundred horse-power. In 1883 and 1884 the most important of Mr. Wheelock's inventions was being developed and tested, the patents upon which were issued in 1885. This was the so-called new system valves, undoubtedly the most original and important departure in engine construction since the invention of Corliss. This well-known valve system has for its main idea the combining of the valve, valve-seat and operating parts within a shell or tapered plug which is driven into a corresponding hole

in the cylinder and retained in place without bonnets or bolts. It also employs an entirely novel method of driving the valve, and combines a number of improvements securing economical results in the use of steam.

Patents were taken out in all the larger manufacturing countries of the world, and much of Mr. Wheelock's time during the years 1886 and 1887 was spent abroad negotiating for the manufacture of the new system engine. His success was such that at the present time it is being extensively built in all these countries. During his absence his home business so greatly declined that in the latter part of 1887 he decided to offer it for sale, which resulted in its purchase by a company organized for the purpose of carrying on the building of the new system engines. The "Wheelock Engine Company" took possession in January, 1888. It is rapidly increasing the business and improving the facilities to meet the demand for the improved engine. New works will be built, new equipment added and other facilities provided.

The Wheelock engine is generally acknowledged to contain some of the best principles of engine construction at present known. Great credit is due to Mr. Wheelock for his inventions, which for originality and importance have been hardly exceeded. His principle of construction bids fair to gain as wide adoption as did that introduced by George H. Corliss forty years ago. It is being applied to marine engines, in which field its opportunities are enormous, and its success already demonstrated.

E. H. Bellows commenced engine-building in August, 1864, renting a shop in Merrifield's building, in Exchange Street. His specialty was portable engines, ranging from the smallest up to forty horse-power. He also built some small stationary engines, not exceeding fifteen to twenty horse-power.

In 1865 Byron Whitcomb became a partner in the business, the firm-name being Bellows & Whitcomb. The same line of manufacture was continued until 1868, when the firm was dissolved.

The Washburn Steam Works were incorporated in 1867, with George I. Washburn, president. The object of the company was to build a novel, high-speed, valveless steam-engine, the invention of Mr. Washburn. The chief peculiarity of the engine and the essence of the invention was in so arranging the pistons of a pair of cylinders that each acted as a valve to the other, performing the functions of inlet and outlet of steam, thus doing away with valves. Its arrangement was upright, with twin cylinders, each having several pistons on one piston-rod. The movement of these compound pistons, passing over and by suitable ports connecting the cylinders, produced the requisite opening and closing for the admission and release of the steam. The stroke of these engines was proportionally very short, and the rotative speed consequently great, which features, in connection with the other mechanical objections, proved fatal to the success of this ingenious invention.

The business was commenced in 1865, in a small up-stairs shop in one of the blocks in Main Street, between Park and Southbridge Streets. In the spring of 1869 the works were removed to the Wheeler building, Hermon Sreet, and again, in the spring of 1871, to Central Street.

The defects of the engines soon becoming apparent, Mr. Washburn turned his attention in another direction, the outcome of which was the Washburn Steam Pump, embodying some of the principles of the engine. The manufacture of this pump was begun in the fall of 1868, and continued with success for a number of years. A serious interruption in the business resulted from the death of Mr. Washburn, in the spring of 1871. In 1872, A. Burlingame, for four years previous foreman of the Washburn Steam Works, bought the business and continued the manufacture of the Washburn Steam Pumps on a considerable scale.

A. Burlingame became connected with the Washburn Steam Works as foreman of the shop in 1868. He bought the business in 1872, continuing under the well-established name of the Washburn Steam Works, and made a specialty of the Washburn Steam Pumps until, 1880, the change to the present firm-name, A. Burlingame & Company, was made. About this time the attention of the firm was turned to steam-engines as a supplement to the pump business, which was suffering from the competition of the injector as a boiler feeder. From a general repair business they gradually went into building plain slide-valve engines up to fifty horse-power, followed by an improved pattern balanced slide-valve engine, and later by a Corliss type engine, each of which is now built by this firm in a full line of sizes up to one hundred horse-power. Additional to engine building is the making of boiler feed-pumps, and the fitting of complete steam plants, beside a large general mill-work and repair business. The location of the Washburn Steam Works, in Central Street, was abandoned by Mr. Burlingame in 1869, when he moved to School Street, remaining in that place until 1883. During this year, 1888, he moved to the present location in Cypress Street.

S. E. Harthan began the manufacture of stationary, semi-portable and launch engines on a small scale at 44 Central Street, in the year 1874.

Increasing business up to 1878–79 required the employment of from twenty to forty men, engaged mostly in building engines of small power of the types mentioned. In 1882 he sold to the Glen Rock Manufacturing Company, of Glen Rock, Pa., that portion of the business relating to stationary and semi-portable engines, including patterns; after which he gave his whole attention to building yacht and launch engines, high and low pressure and compound, together with complete steam outfits. Becoming engaged in electric work, the engine building has been gradually abandoned until at the present

time he is practically out of the business, engaging in it only to the extent of building an occasional engine for electric purposes.

Besides many stationary engines, he has built the steam machinery for about fifty-three yachts and launches, amongst which was a very fine private yacht for Jacob Lorillard, another for Mary Anderson, and one for Chauncy Ives, of New York, as well as seven smaller boats for Lake Quinsigamond, Worcester.

Clark & Knight established the business of engine-building in 1877. They manufactured upright engines up to thirty horse-power. The business is now conducted by E. O. Knight.[1]

Mr. Frank Copeland, gunmaker, 17 Hermon Street, makes small vertical steam-engines from one to twenty horse-power.

Boilers.—The Stewart Boiler Works were established in 1864 as Stewart & Dillon. Mr. Charles Stewart learned his trade in Hull, England. He came to Worcester first to manufacture boilers for Bellows & Whitcomb, who were building engines.

In 1869, C. Stewart succeeded to the business, and prior to 1872 had purchased the boiler business of Rice, Barton & Fales.

Mr. Stewart and William Allen were in partnership from 1872 to 1875, when they dissolved. The business has since been conducted by Charles Stewart and C. Stewart & Son. Their castings are all made in the city, and their boiler-plate from American steel. They manufacture locomotive and stationary boilers.

William Allen & Sons were established in 1875, after the dissolution of the partnership between Stewart & Allen. They were first situated in Southbridge Street, near the Junction, and in 1823 removed to their present location in Green Street, in the old shops of the New York Steam-Engine Company.

They manufacture all classes of steam-boilers,—tubular, locomotive and marine boilers, feed-water heaters, bleaching kiers, dye-well extractors and iron tanks of all kinds; iron cases for water-wheels and boilers for residences; have an iron and brass-foundry, and make their own castings. They occupy a substantial brick two-story building, a boiler-shop and foundry, and occupy sixty thousand feet of land.

Mr. William Allen is an Englishman, and served his apprenticeship at the works of James Watt, Birmingham, England.

[1] I am indebted to Mr. E. K. Hill for much of the material used in the article on steam-engines. C. G. W.

CHAPTER VIII.

WORCESTER—(*Continued.*)

MANUFACTURING AND MECHANICAL INDUSTRIES.

Boots and Shoes—Bigelow Heeling-Machine—Leather Belting—Boot and Shoe Machinery—Lasts—Dies.

Boots and Shoes.—From Caleb A. Wall's Reminiscences we learn that Captain Palmer Goulding, a cordwainer, came to Worcester just previous to the first organization of the town, and built a house on the east of the Common, where his son Palmer, Jr., and grandson Daniel afterwards lived. They also carried on the business of tanning, shoe-making, making malt, curing hams, etc. Their place of business was in front of their dwelling, and occupied ground between, what are now Front, Mechanic, Church and Spring Streets.

Almost every town had a tanyard, and leather of sufficiently good quality was made to serve the needs of the shoemakers and saddlers.

The embargo and War of 1812 greatly stimulated the cordwainers, who began to make boots and shoes in quantities in anticipation of the wants of their customers, and when a few dozen pairs had accumulated, they were put in saddle-bags and taken to market, principally Bristol, R. I., the first wholesale boot and shoe market in the country, it being a sea-port town.

At this time the bottoms of all boots and shoes were sewed on; putting them on with pegs was an invention of a later date, and very greatly reduced the cost; this improvement aided materially in the development of the industry. Among the first to adopt it was Joseph Walker, of Hopkinton, Mass.

The next step in the development of the boot and shoe industry was for the makers of leather to sell it to merchants in the larger towns and cities, who, in turn, sold to the shoemakers, and they, in course of time, paid for it out of the product, in boots and shoes, which were sold by the leather dealers to the jobbers in Bristol, Providence, Boston and New York. These cities held the trade for many years.

The next step in the development was the separation of the leather business from boot and shoe manufacturing, the firms dealing in the leather requiring money payment for leather and the boot and shoe manufacturers selling their product to firms dealing in boots and shoes only, who, in turn, sold them, usually by the case of sixty pairs of shoes and twelve pair of boots, to country store-keepers, who from that time have kept them in stock as universally as dry-goods or groceries.

Among the first towns in which this business was begun was Hopkinton; then in the adjoining town of Milford; and about the same time in several other eastern towns; shortly afterwards in Grafton, where Oliver Ward learned his trade of Clark Brown. Mr. Ward started in business in North Brookfield in 1810,

and from the history of North Brookfield we learn that "he made his own pegs; maple logs were sawed in sections of the proper length, which were then split with a long knife and the splint divided into pegs. The next improvement was to cut the points of the pegs in the blocks with a knife and mallet before splitting; and the next was to cut the points with the tail gouge driven like a carpenter's plane; and the next to do the whole by machinery."

Tyler Batcheller, of Brookfield, also learned the shoemaker's trade in Grafton, and, returning to Brookfield, commenced business in 1819, with his brother Ezra, who learned his trade of Oliver Ward.

Worcester was more than a quarter of a century behind these towns in the boot and shoe business, but has to-day an important place in this industry.

Previous to 1813 the only man engaged in boot and shoemaking in Worcester was John Tyler Hubbard, whose shop was on Front Street, corner of Spring.

He would hardly be called a manufacturer at the present day, as he did business in a very small way, and, when he had accumulated a few dozen pairs, would take them to Bristol, R. I., for sale.

In 1813 John Dolliver and Foster Newell made for the market ladies' morocco and kid shoes opposite the Court-House.

In February, 1818, Earle & Chase had a quantity of goat-skin leather dressed in the manner of black kid, which they were having manufactured into shoes and boots.

In 1824 Benjamin B. Otis commenced business near the harness shop of Enos Tucker, and continued until 1850, part of the time with John C. Otis, as B. B. Otis & Co. In 1850 C. H. Fitch became a partner, the firm-name being Otis, Fitch & Co. The same year B. B. Otis retired, and a new firm was organized of Fitch & Otis, which continued until 1860. For three years from 1863 the firm was Dike & Fitch, and from that time until 1886 the business was conducted under the name of C. H. Fitch & Co.

In 1828 Scott & Smith were manufacturing ladies' shoes of various kinds, nearly opposite the Central meeting-house, at the sign of "The Golden Slipper," where they made ladies' kid and double prunella walking shoes and pumps.

In 1834 Charles Wolcot and Nathaniel Stone had a shop three doors south of the Centre School-house, under the *Ægis* printing-office, where they manufactured boots and shoes, also ladies' kid, morocco and satin shoes. In the same year Thomas Howe & Co., at the head of Front Street, advertised for eight or ten journeymen to make bootees for the Military Academy at West Point.

Barnard & Hager were at the same time making goods on Front Street, corner of Summer.

In 1835 T. S. Stone began to manufacture in Washington Square, and in that year and the year following, he took a premium for his boots at the Cattle Show.

In 1839 he admitted as a partner, Ansel Lakin, who was with him but a short time. Mr. Stone continued with various partners until 1864, when Samuel Brown became associated with him. In 1868 A. G. Walker entered the firm, and the business was conducted under the name of Stone, Walker & Brown. In 1871 the firm was again changed, Messrs. Brown and Walker retiring and Mr. Stone's sons being admitted. The business was continued until Mr. Stone's death, in 1873.

George and Ebenezer H. Bowen came from Leicester, and commenced the currying of leather, as early as 1836, from which time for twenty years, they were in addition, directly and indirectly connected with the manufacture of boots and shoes.

In 1837 Ansel Lakin began in a small way in the village of Tatnuck, and was afterwards in partnership with Timothy S. Stone. In 1841 he was doing business with Bemis & Williams, and after this he continued with various partners for nearly twenty years.

In 1838 Wm. A. Draper came from Spencer and started in business in Pleasant Street. In 1842 Otis Corbet was admitted to the firm and they continued until 1847, when Mr. Draper went out and the business was conducted by Mr. Corbet alone. In 1850 Mr. Draper returned, and for two years the firm was Wm. A. Draper & Co.

In 1842 E. H. Bowen and William Barker began to manufacture as E. H. Bowen & Co. Barker retired in 1841, and Bowen formed a partnership with T. S. Stone, under the firm-name of Bowen & Stone, which was dissolved in 1848. After this, Bowen continued alone until 1857.

In 1843 Joseph Walker came to Worcester from Hopkinton, and began business in a wooden building in Front Street. In 1844 the firm of Barker & Walker was formed, occupying a building at the corner of Main Street and Lincoln Square. Mr. Barker retired from the firm in 1846. Joseph Walker continued alone until 1851, when his eldest son, J. H., being of age, was admitted, and the firm-name was Joseph Walker & Co., their place of business being at Lincoln Square. G. M. and A. C. Walker, two other sons, were admited to partnership on their becoming of age. In 1862 this firm dissolved, J. Walker and his son, A. C. Walker, continuing under the old name until 1871.

In 1845 Cyrus, William R. and George W. Bliss moved their business from Milford to Worcester, and continued until 1853. George W. Bliss then succeeded to the business and moved into the Merrifield Building in Union Street, retiring in 1857.

Levi V. Dowley was at this time manufacturing brogan shoes in a small way.

In 1846, on the dissolution of the partnership of Barker & Walker, Wm. Barker commenced business on his own account, and was alone until 1850, when Courtland Newton was admitted, remaining in the firm till 1855. In 1857 Newton Penniman was

admitted. Mr. Barker afterwards continued for several years alone.

In 1847 J. Munyan was manufacturing shoes in Main Street, and continued until 1850.

In 1849 Rufus Wesson, Jr., came to Worcester from Shrewsbury, and was in business in Harding's Block, 45 Front Street, until 1873. His son, J. E. Wesson, began alone in 1868, and is now doing a large business in Mulberry Street.

In 1851 W. A. S. Smythe commenced the manufacture of shoes at the corner of Union and Market Streets. In 1860 his brother, Robert L. Smythe, joined him. They gave up manufacturing in 1872, being then situated in Foster Street.

In 1852 Hiram French succeeded to the business of Wm. A. Corbet, and continued the manufacture of boots until 1871.

In 1853 Aaron G. Walker commenced manufacturing, and continued alone until 1857, when he went into company with E. N. Childs.

In 1853 C. C. Houghton began the manufacture of boots at Lincoln Square. In 1857 he admitted his brother, Alba Houghton, into the partnership of C. C. Houghton & Co., and continued with him until 1864, when Alba Houghton retired. In 1864 the partnership of Houghton & Heywood was formed and was dissolved in 1867. H. B. Adams was then admitted, and the firm of Houghton & Adams continued for one year.

Mr. Houghton was alone until 1871, when Wm. Warren became a partner, the firm-name being C. C. Houghton & Co. Mr. Warren retired in 1884. At present the firm consists of C. C. Houghton, F. N. Houghton and E. W. Warren, and is known as C. C. Houghton & Co., which is situated in Houghton's Block, corner of Front St. and Salem Square.

In 1853 E. N. Childs came to Worcester from Millbury, and engaged in business with Albert Gould for one year. In 1854 Albert S. Brown became a partner. They did business as Childs & Brown until 1857, when Mr. Brown retired, and A. G. Walker was admitted into the firm of E. N. Childs & Co. In 1862 Mr. Walker retired, and Mr. Childs continued under the same firm-name until 1881. During the last few years his sons were interested with him in the business.

In 1855 Luther Stowe came to Worcester from Grafton and commenced business in Mechanic Street, soon after which he formed a partnership with E. A. Muzzy, as E. A. Muzzy & Co. The firm dissolved in 1865. Mr. Stowe and Mr. J. F. Davenport, under the title of L. Stowe & Co., commenced business in Washington Square. In 1875 Mr. Davenport retired, and the business was continued under the firm-name of Luther Stowe & Co. In 1880 they moved to a factory in Grafton Street, and still continue there under the old firm-name, Mr. Stowe's son now being a partner.

In 1857 David Cummings began with Mr. Hudson, the firm-name being Cummings & Hudson. Mr. Hudson retired in 1862, and Mr. Cummings continued alone until 1866, when he left Worcester. He returned in 1880, and with his partners, E. H. Hurlbert and D. E. Spencer, built and occupied the factory in King Street, now occupied by them.

E. A. Muzzy and Luther Stowe commenced manufacturing, in 1857, as E. A. Muzzy & Co., continuing until 1865, when Mr. Stowe went out and Mr. Muzzy retired from manufacturing, the business being continued by G. L. Battelle and F. A. Muzzy, under the old name of E. A. Muzzy & Co., until 1875.

In 1860 H. B. Jenks came to Worcester from North Brookfield, and commenced the manufacture of boots and shoes, continuing until 1871.

Also, in 1860, H. B. Fay came to Worcester from Shrewsbury. He continued to manufacture until 1887, most of the time under the firm-name of H. B. Fay & Co.

In 1862 J. H. Walker commenced business in Eaton Place. In 1864 George M. Walker was admitted, the firm-name being changed to J. H. & G. M. Walker. They afterwards built a factory in Front Street and one in Eaton Place. In 1870 they built and moved to a factory in Water Street, the capacity of which was doubled in 1879. G. M. Walker retired in 1870. Samuel Davenport took his place, and in 1880 H. Y. Simpson was also admitted, the firm-name always remaining J. H. & G. M. Walker. The specialty of this firm was the widely-known "Walker boot." They retired from business January, 1888.

In 1863 J. W. Brigham & Co., who had been manufacturing for three or four years in a small building near the junction of Main and Southbridge Streets, built and moved into the factory in Southbridge Street, where they now are.

In 1864 Bigelow & Trask commenced the manufacture of shoes in Austin Street. In 1866 they were incorporated under the name of the Bay State Shoe and Leather Company, and have been doing business under that name ever since at the same place. The headquarters of this corporation is in New York, J. Munyan, before referred to as manufacturing in 1847, is vice-president and Worcester agent.

In 1865 E. H. and O. N. Stark formed a partnership under the name of E. H. Stark & Co., and have continued without change, and are at the present time located in Main Street, above Myrtle.

In 1866 Simon J. Woodbury, of Sutton, moved a building from that place to the site of the shop now occupied by Goddard, Fay & Stone, and he, with others, manufactured for a short time. In 1866 Rawson & Linnell moved their business from West Boylston to Worcester, bringing with them twenty-two families and commenced manufacturing in Pleasant Street, near Main, under the name of E. C. Linnell & Co. In 1868 they built a factory on the site of the Woodbury building in Austin Street. Mr. Linnell withdrew in 1869, and a new firm was organized under the name of D. G. Rawson & Co., consisting of D. G.

Rawson, D. S. Goddard, W. B. Fay, which continued until 1881.

In 1867 Alba Houghton withdrew from the firm of C. C. Houghton & Co. and commenced business on his own account under the name of Alba Houghton & Co. and continued until 1882. In 1867, on the dissolution of the firm of Houghton & Heywood, S. R. Heywood went into business for himself and was alone until 1873, when Oscar Phillips was admitted as a partner, and business was done under the firm-name of S. R. Heywood & Co. In 1880 they moved to their new factory in Winter Street, and in 1881 were incorporated under the name of the Heywood Boot and Shoe Company. The specialty of this corporation is the widely-known "Wachusett Boot," and fine sewed shoes.

In 1871, A. G. Walker and Samuel Brown withdrew from the firm of Stone, Walker & Brown, and, commencing under the name of Walker & Brown, continued until 1879, when Mr. Walker retired. Mr. Brown went on alone under the same firm-name, and is at present doing business as Walker & Brown, in Barton Place, his son being a partner.

In 1871, Whitcomb, Dadmun & Stowe commenced in Southbridge Street, and continued for four years, when the firm dissolved, and C. C. & C. H. Whitcomb formed a new partnership, under the name of Whitcomb Brothers, and were manufacturing for nine years, when the firm was again dissolved. They were succeeded by C. C. Whitcomb and E. B. Miles, under the name of Whitcomb & Miles, who are now manufacturing in Shrewsbury Street.

In 1872, H. B. Adams, H. W. Hastings and A. C. Walker, began business in the block corner of Allen Court, second story, and then moved to Cherry Street, and, under the name of Adams & Hastings, continued until 1878.

In 1875, J. F. Davenport left the firm of L. Stowe & Co., and he, with Alfred W. Long, started in Eaton Place as Davenport & Long, continuing until 1885.

In 1875, G. L. Battelle, under the name of G. L. Battelle & Co., succeeded E. A. Muzzy & Co., and engaged in the manufacture of a cloth-boot, called "Alaskas," and custom boots and shoes. He is situated in Mechanic Street.

In 1878, J. U. Green, coming from Spencer, began business in Cherry Street, under the name of J. U. Green & Co., afterwards moving to Front Street, where he continued in business until 1882.

In 1881, upon the dissolution of the partnership of D. G. Rawson & Co., C. S. Goddard, W. B. Fay and A. M. Stone, formed a new company, under the name of Goddard, Fay & Stone, and continued in business until January 1, 1889, when they were succeeded by Goddard, Stone & Co. They have always occupied the factory where they are now located in Austin Street, the capacity of which was doubled by them in 1886.

In 1883, Bemis & Fletcher began business in Mechanic Street, under the name of the Waverly Shoe Company, and are at present located in Front Street. Their specialty is the "Waverly School Shoe."

In 1888, F. W. Blacker, who was with the firm of J. H. & G. M. Walker from 1865 until their retirement, succeeded to the business, leasing the old Walker factory, in Eaton Place, with its machinery, tools and patterns, and continues to make the widely-celebrated "Walker Boot."

Until the year 1868 nearly all the boots and shoes manufactured in Worcester were hand-made, machinery, excepting the sewing-machine, being little used.

Worcester manufacturers were always slow in adopting boot and shoe machinery, and they did not use it until long after it had been adopted in other places. From 1850 to 1868 a large proportion of the boots and shoes were taken to the adjoining towns of West Boylston, Oakdale, Holden, Grafton, Millbury and Auburn to have the bottom stock put on; and then they were brought back and finished in the factories in Worcester.

Since 1868 the quantity thus bottomed has steadily decreased. There was at one time a great prejudice among consumers against goods made by machinery hand-made work being considered far superior, and for the first few years after the introduction of the pegging-machine, it was absolutely necessary that the manufacturer "sand off" from the bottom of every boot the impressions made by the machine, for fear the boots might be rejected by the customer. To such an extent was this feeling carried, that as late as 1870 large quantities of goods were sold stamped "Warranted Hand-made," on which nearly the whole work was done by machinery.

There is probably no industry where the improvement in manufacturing has been so radical and complete as in this. The only department where there has not been a great improvement is in that of the upper leather cutting and treeing. The cutting of upper leather is done by hand, and probably always will be. Treeing is done substantially as it was when boots were first made, and, although machines have been invented for doing this work, they have never been considered satisfactory.

By the use of machinery in its present perfected state, goods can be produced that are more uniform than any that can be made by hand. A striking feature in the manufacture of boots and shoes is the division of labor. As far back as 1840 all who called themselves shoemakers were able to take leather in the side and complete a perfect boot or shoe. In these days, in the large factories an ordinary boot will go through the hands of fifty or sixty different persons, the work in each room being minutely divided, and few of the men being skilled in any but their particular part. This is one reason why boots and shoes are produced and sold so cheaply at the present time. Each man takes up that branch to which he is best

adapted, and continual practice makes him an adept. The cost of labor on a case of twelve pairs of ordinary heavy boots, at the present time, is about five dollars. To produce the same number of boots by hand, by old methods, would take the wages of two weeks.

The making of lasts, patterns and dies now used, has been so far reduced to a science that one can go into a first-class boot and shoe store and procure boots or shoes that will fit him perfectly.

Worcester is practically what is called a boot town, comparatively few shoes being made, and the only factories to-day that devote themselves exclusively to the manufacture of women's, misses' and children's shoes are those of J. E. Wesson and the Waverly Shoe Company, which are now making what is called "Medium Grade" and "Weight Shoes."

Heavy shoes, called "brogans," and plow-shoes are made, but these are considered about the same as boots, and are usually made in the same factories by the same workmen. Efforts have been made by various manufacturers to introduce men's fine shoes, which have partially succeeded, though not sufficiently to allow of Worcester being classed as a shoe town.

In treating of the boot and shoe industry, it is not generally understood that the manufacture of boots and shoes is distinct. A workman is seldom found who can do equally well on each kind of work. The manufacture of ladies' fine shoes, such as are made in Haverhill and Lynn, has never been attempted here. In order to do this it would be necessary to obtain the help from those towns, and this has always been found unsatisfactory. Many attempts to make boots in shoe towns have failed, and the fact is fully recognized.

The manufacture of boots and shoes is now, and has been for years, one of the leading industries of Worcester, and has been uniformly successful. This is not due to the manufacturers alone. In most of the large boot and shoe towns the workmen are the unsettled population. In Worcester it is not so. Nearly all are permanent residents, a large number owning their homes, and, even in times of great business depression, few leave the city. To this fact must be largely attributed the absence of strikes. While other places have been visited with labor troubles, but two strikes of any consequence have been known here, one in 1867 and one in 1887.

It is to the credit of employer and employés that they have considered their interests mutual, thus enabling the differences between them to be readily and satisfactorily adjusted.

It is worthy of notice that, with scarcely an exception, none of the present or past manufacturers of Worcester have had any educational advantages superior to those of the common school. They nearly all learned their trade at the bench, and to this, in a great measure, must be attributed their success. Being able to do any part of the work themselves, they are competent to judge if the work is properly done by others. They have proved themselves to be enterprising and worthy citizens, and have held a full share of the honorable positions in the gift of their fellow-townsmen. They have been represented in the directories of the various banks, in the Common Council, Board of Aldermen, State Legislature, and will be represented in the Fifty-first United States Congress.[1]

The Bigelow Heeling-Machine.—This machine is an improvement upon the McKay machine, with which its interests are now identified. Mr. H. H. Bigelow patented the heel in 1869, and the machine in 1870.

The advantages conferred by this machine are manifold. By means of it all the odd or "V"-shaped pieces of sole leather, which were formerly considered worthless, are utilized. These are joined or fitted closely together, under a solid upper lift, and fed to the machine, which consists of a revolving cylinder, making one revolution in four motions. First, the heel is pressed; then, a quarter revolution and the heel is pricked for the nails; then, another quarter revolution and the nails are driven; with the final quarter revolution the completed heel is forced from the cylinder.

The machine not only utilizes pieces of leather of every kind and shape, but takes all heels, whether whole, half or quarter lifts, and saves one good lift on each boot or shoe heel, since the leather which would otherwise be trimmed off is, by reason of the equal pressure upon the heel from all sides, evenly and smoothly forced into the heel, elevating it, and making a difference of one entire lift in height. A good lift is worth about two cents.

The machine not only makes pieced heels, but all styles, heights, shapes and sizes, and is undoubtedly the most valuable contribution that has been made to this industry, since while it effects the greatest saving it accomplishes the most laborious part of the work. With it, a man and boy can heel five thousand pairs of boots or shoes in a day, effecting a saving of the wages of forty-eight additional operatives per day.

The amount of royalty upon a pair of boots or shoes is one-half of one cent, but by the saving of leather, and the saving of wages, the seller is not only able to dispose of his goods at a less price, but the durability of the boot or shoe is increased tenfold by means of this improvement in the method of manufacture.

No boot or shoe manufacturer could carry on a large business successfully without the Bigelow Heeling-Machine, and the fact that he could not otherwise compete, proves conclusively that the purchaser is the person most largely benefited.

[1] I am indebted to Mr. J. H. Walker and Mr. F. W. Blacker for some of the material used in the chapter upon Boots and Shoes.—C. G. W.

A. H. Dean, in 1866, established the business of manufacturing shoe-heels from upper leather remnants bought at the boot and shoe factories. He was among the first in the country to engage in this occupation as a distinct business. Heels had been made for the most part of sole leather in shoe factories. Most of this work is done by hand. The heel pieces are cut by dies. The business has so grown that there are now two hundred concerns in the country in this special line of work. From twelve hands Mr. Dean's business has grown into the employment of one hundred and fifty.

In March, 1861, T. K. Earle & Co. sold their belt manufacturing tools to Graton & Knight, a firm formed March 11, 1861, and composed of H. C. Graton and Joseph A. Knight, located in Harding's Block, on Front Street. They started their tannery on the Bloomingdale Road in 1867, and now put in about six hundred hides per week. They use oak bark, which is ground in Virginia. The belting is taken in strips from the tannery to the Front Street shop, each hide affording three strips suitable for this purpose. This is at present the only tannery in the city. In the upper story of the Bloomingdale Building they manufacture inner-soles and slip-taps, and heels of all kinds, made from sole leather. In this way the shoulders and bellies are used. They also make sole-leather counters for boots and shoes, moulded and flat counters of all kinds, straps for looms and pickers and for harvesting-machines. They started in Foster Street with three hands, and at that time had a shop in Lynn; that branch of the business was later removed to Worcester. They now employ ninety hands, and ship part of their product to England. There are but four larger concerns in the belt business in the country.

H. O. Hudson & Co., successors to Peter Goulding, established in 1854, manufacture leather belting, rubber belting, loom straps, etc.

J. F. & C. G. Warren also manufacture leather belting.

Boot and shoe and belting machinery is made by A. F. Stowe, on Cypress Street.

H. C. Pease & Co. and John J. Adams also manufacture shoe machinery.

Samuel Mawhinney, in company with Mr. A. P. Richardson, commenced the manufacture of lasts January 1, 1857, in Merrifield's Building. At that time the lasts were turned out in the rough in Canada and finished in Worcester. In 1868 Mr. Richardson retired, and in 1869 Mr. Mawhinney bought land on Church Street and built his present shop. About that time Mr. R. L. Colbert became a partner. The business has constantly increased, and now employs from twenty-five to thirty hands. One hundred thousand pairs of lasts are made annually. The material used is rock maple. In addition to the last business, this company makes boot and shoe trees.

DIE MANUFACTURERS.—Mr. A. M. Howe began the die business in Westboro' in the year 1857, and moved to Worcester in 1860. In 1861 he had a contract from the Government to make primers for guns. Mr. Howe makes boot and shoe, envelope and harness dies; in fact, cutting dies of almost every description. He formerly bought his die stock from the Coes', but now prepares it under a patented process of his own.

Davis, Savells & Co. is the only other concern in the city which makes dies. They commenced business in 1870. Mr. Davis was formerly in the employ of A. M. Howe.

CHAPTER IX.

MANUFACTURING AND MECHANICAL INDUSTRIES.

Paper Machinery—Razors—Holyoke Machine Company—Norton Emery Wheel Company—Corsets—Skates—Chairs—Gas—Contractors and Builders—Summary of Industries not heretofore mentioned.

PAPER MACHINERY.—Isaac Goddard was born in South Royalston, Vt., in 1800. He came to Massachusetts in 1812, and was apprenticed to Elijah Burbank at Quinsigamond to learn paper-making. After serving his time, he went to Millbury, and about 1823 made paper there by the pound for General Burbank. In 1836 he came to Worcester, formed a partnership with Mr. Howe, and, under the firm-name of Howe & Goddard, began making paper machinery at the old Red Mills. It is said that six months after starting they put in a steam-engine of six horse-power. This they used for two years, in conjunction with their water-power. February 1, 1843, they moved to the Union Street factory, now occupied by their successors. In the summer of 1846 Mr. Howe died, and Mr. George M. Rice shortly after became a partner.[1]

In April, 1856, Goddard, Rice & Co. bought from Isaac Davis, for thirty-one thousand dollars, the factory occupied by them in Union Street. April 1, 1862, Goddard, Rice & Co. dissolved, and May 1st George M. Rice, George S. Barton and Joseph E. Fales formed a company for the manufacture of machinery under the style of Rice, Barton & Co. At this time they advertised to make steam boilers, and in 1863 manufactured the Vandewater Water-wheel.

The Rice, Barton & Fales Machine and Iron Company was organized in 1867, and succeeded to the business of manufacturing paper-making, calico-printing and dyeing machinery, printing and dyeing-machines for cotton and woolen-mills, bleaching,

[1] George S. Barton came to Worcester in 1845, was apprenticed to Howe & Goddard, and in 1849 became a partner in Goddard, Rice & Co.

paper-printing machinery, hydraulic presses, architectural iron and other large work.

Razors.—J. R. Torrey & Co. manufacture razor strops and dressing-cases, and are situated at the corner of Piedmont and Chandler Streets. The business was begun in a very small way in 1858 by J. R. Torrey. In 1875 his son, L. H. Torrey, was admitted to partnership. The business has increased until they have become the largest manufacturers of razor strops in the world.

The J. R. Torrey Razor Company was incorporated in 1880—Joseph Turner, president, and J. R. Torrey, treasurer. The present factory was erected in 1882.

This is the only company manufacturing razors in the country. Commencing with eight hands, their force to-day, 1889, numbers seventy-five razor-makers, with more special tools and machines of their own invention than are found in all the razor factories in the world.

The Holyoke Machine Company.—This company was established at Holyoke in 1863. In 1882 a branch factory was built at Worcester, situated opposite the old Wheeler Foundry on Thomas Street. This company manufactures the Hercules Turbine Water-Wheel. One-fourth of their product is sold abroad. They commenced with fifty men and now employ one hundred and fifty. They also manufacture shafting, hangers and pulleys.

Norton Emery-Wheel Company.—This company was organized June 20, 1885. The industry was started in 1875 by F. B. Norton at the old Pottery Works in Water Street, from whom the wheel takes its name. The pottery business is still conducted by Mr. Norton's sons in Water Street.

In July, 1886, the Norton Emery-Wheel Company began the erection of new works at Barber's Crossing, about three miles from the centre of the city, at the junction of the Boston and Maine and Fitchburg Railroads. The building was finished and occupied about January 1, 1887, and is more complete and thoroughly equipped than any other manufactory of emery-wheels in the world. The method of producing solid emery-wheels by this company is known as the vitrified process and is covered by three patents. The wheels possess great strength and endurance, are thoroughly water-proof, containing no substance that has not abrasive properties which ensures their fast-cutting qualities. The best Turkish emery ore and pure corundum are used. During the process the wheel is subjected to a white heat, for which purpose the Lawton Patent Down-Draft Kilns are used.

These wheels are used for all descriptions of light and heavy casting-work, car-wheel grinding, cleaning hollow-ware, pearling barley, cleaning wheat and cotton seed, wood pulp, grinding, planing and surfacing work, cutlery work, concaving razors and other uses too numerous to mention.

Brown & Sharpe Manufacturing Company of Providence, R. I., has succeeded in producing remarkable results with these wheels in the direction of fine grinding.

Corsets.—In the year 1861 Mr. D. H. Fanning finding that hoopskirts were becoming popular, secured a small room in what was then Clark's Block, situated at the corner of Main and Mechanic Streets, and with one operative began their manufacture.

The product of this small establishment found a ready sale. He continued the manufacture of hoopskirts exclusively until the year 1864, when the manufacture of corsets was introduced into this country and Mr. Fanning added this industry.

The plant was enlarged to meet the increasing demands made upon it. In 1872 the business was removed to the Rice building, 564 Main Street. The manufacture of corsets proved the more important part, and at length the manufacture of skirts was discontinued. The name of the firm, at first the Worcester Skirt Company, was changed to the Worcester Corset Company, which was afterwards made the corporate name of the present organization.

The business continued to develop, and subsequently a section of the Franklin building, adjoining, was added. In 1880 the Heywood building, located in the rear of the Rice building, was added to the other two. The plant now includes these three buildings with a floor area of fifty thousand square feet.

The sewing-machines used are of the Singer make. The old machines were run at a speed of from four hundred to six hundred stitches per minute, while those now in use have a capacity of from fourteen hundred to eighteen hundred stitches per minute.

In 1885, finding the market for its products reaching over a constantly increasing area, at length covering the entire country, the Worcester Corset Company established branch sales-rooms in Chicago, Ill., the great distributing point for the West and Northwest, and also opened an office in New York City.

Within the past year the company has entered extensively into the manufacture of fine goods in which silks, pongees, satins, French cotilles and American jeans are used.

By engaging in the manufacture of fine goods, the company gives employment to an increased number of skilled workmen of the highest class. These goods are of the same grade and come into competition with the finest quality of French and German corsets; and there is no concern in the country engaged in this business so thoroughly equipped for the production of fine goods as the Worcester Corset Company.

In size it ranks among the largest producers in the country of all grades of corsets, and probably the largest in the production of fine goods. Five hundred operatives, mostly women, are employed in this establishment.

The Park Corset Works, in Front Street, was established in 1868, and incorporated in 1885.

In 1856 S. C. & S. Winslow, who had been engaged in mechanical business at Newton Upper Falls, occupied a small room in Cypress Street, in Merrifield's building, doing machine jobbing.

In 1857, observing that skating was becoming popular, they ventured to make twenty-five pairs of skates, of which they sold nineteen pair during the first year.

In 1858, in anticipation of the demand, they manufactured two hundred pairs, but before the end of the year had manufactured and sold two thousand five hundred pairs.

Seth C. Winslow died in 1871, and his interest was purchased by Samuel Winslow.

In 1872 Mr. Winslow made roller-skates for J. L. Plympton, of New York, which were used in this country, and exported to Europe and to India, and continued to manufacture them for several years; meantime the business had so increased that a factory was built in Mulberry Street.

In 1880 Mr. Winslow invented the Vineyard roller-skate, which has been the most popular roller-skate made. The demand in this country for roller-skates continued till the fall of 1885.

During the year 1884 Mr. Winslow built an addition to his factory. In 1886 he sold his business to the Samuel Winslow Skate Manufacturing Company.

At the present time, 1889, the demand for roller-skates in the United States has ceased, but the company is exporting them to Australia, India, Japan and South America.

The capacity of the company is twelve hundred pairs of skates per day, including forty different styles of ice-skates and fifteen different styles of roller-skates, which vary in price from fifteen cents to ten dollars per pair.

This company also manufactures an excellent bicycle, which is sold at a moderate price, and which is finding a ready market for the reason that it is as durable as the more expensive machine.

Folding Chairs.—In 1863, Mr. E. W. Vaill, who had previously been in the furniture business, engaged in the manufacture of camp-chairs, which were in large demand by the army and navy. The business was begun at the corner of Main & Walnut Streets, but in January, 1877, was moved to Union Street, the present location. The old water-wheel, which furnished power for Ruggles, Nourse & Mason, at Court Mills, supplies twenty-eight horse-power for this factory.

At the close of the war the demand for camp-chairs largely decreased, but the principle was carried into all variety of chairs, from the plainest to the most expensive. Over one hundred different styles were made, many of which were patented, and they were sent all over the world. February 5, 1889, the E. W. Vaill Chair Manufacturing Company was incorporated and succeeded to the business.

The Worcester Gas Light Company was organized June 22, 1849, with a capital of $45,000. John W. Lincoln was president, and Warren Lazell, agent.

The works were built in Lincoln Street, and, under date of July 23, 1849, the company gives notice in the Worcester *Spy* that the works will be ready to supply gas to the citizens of Worcester in the following streets, early the next fall, viz.: Main Street, from Lincoln Square to Park Street School, Thomas' Exchange, Foster and Mechanic Streets, severally, between Main and the railroads; also in Front from Main Street to Washington Square, and in Pleasant Street from Main to Chestnut Streets.

Those desirous of becoming consumers of gas were requested to give early notice at the office of the agent, 205 Main Street, in order that supply-pipes might be carried into their buildings, the pipes to be put in at the expense of the company.

The company was incorporated in 1851; the works were enlarged from time to time, and in 1870 were removed to the present site near the Junction.

The present estimated capacity of the works per day is 750,000 cubic feet. Gas made during the year ending June 1, 1888, 100,724,500 cubic feet; greatest output December 24, 1887, 501,300 cubic feet; least output, June 17, 1888, 112,600 cubic feet; total length of street mains, 201,950 feet; total number of meters in use June, 1888, 3,882.

The manufacture of water-gas was introduced in October, 1884, the company having purchased a license under the patents of the Granger Water-Gas Company, of Philadelphia.

Contractors and Builders.—There is a large number of contractors and builders in Worcester, some of whom have attained a wide reputation for the character of their work. The wood-work in some of the most expensive houses in the country has been furnished by Worcester firms.

Charles Baker & Co. make a specialty of inside and outside ornamental finish from architects' plans.

The Norcross Bros. stand pre-eminent among builders in Worcester, and their reputation has now become national. They own stone quarries at Long Meadow and have shops equipped to produce every kind and variety of work required in the most elaborate buildings.

The Norcross Bros. began business at Swampscott, Mass., in 1864, and 1866 took their first contract of any consequence, which was to build the Congregational Church in Leicester.

Since that time they have built educational structures, business blocks, churches, public buildings, club-houses and private residences.

Among the buildings erected by them are the Worcester High School, Crompton's Block, Burnside Building, All Saints' Church, the First Universalist Church, all of Worcester.

Their most expensive buildings have been erected elsewhere. The gymnasium, Seaver Hall and the Law School at Harvard University; the Marshal

Field Building, at Chicago, erected in 1885 at a cost of $900,000; the New York Life Insurance Building, at Omaha, costing over $500,000; another building for the same insurance company in Kansas City, costing a like amount; the Allegheny Court-house and jail, at Pittsburgh, costing $2,500,000; the Union League Club-house, New York; the Algonquin Club-house, Boston; besides many private residences, the most expensive of which is "Kellogg Terrace," Great Barrington, which cost $600,000.

It has not been attempted to give an extended account of all the manufactories in Worcester; space and time would not permit of this. The following alphabetical summary of most of those not hitherto mentioned in the text will give some idea of their variety and number:

Agricultural Machinery.—B. F. Goddard, mowing-machines, 195 Front Street.

Awls.—American Awl Company, 195 Front Street, manufacturers of and dealers in raw-hide mallets, wax thread needles, lasting-machine awls, wax thread awls, Bigelow heeling awls, Bigelow heeling drivers, New Era drivers, New Era pegging awls, Varney pegging awls, Varney drivers, German pegging drivers, German pegging awls, shoe-knives, shoe-shaves.

J. McCarty, 19 Church Street, proprietor National Awl Company; established 1878; machine awls for pegging-machines.

Sumner Packard & Co., of Grafton, made the first machine awls for boot and shoe-pegging machines.

Band-Saws.—W. F. Burgess & Co., 66 School Street.

Bicycles.—Iver Johnson & Co.; Samuel Winslow.

Bolt Manufacturers.—In 1828 Wheelock & Rice manufactured nuts and washers at the machine-shop then recently occupied by William Hovey.

In 1839 H. W. Miller was engaged in this business.

In 1855 Thomas Smith and William Conkey bought of J. and J. C. Brown and George Dryden their tools and interest in the manufacture of nuts and washers, chain links, etc., and fitted up a shop in Cypress Street, Merrifield's building. In 1859 they employed four hands making patent bit pieces and doing cold punching. Mr. Smith has been an iron-worker in Worcester for fifty-three years; he made the first die in the world to make a mowing-machine knife. He now manufactures bolts, nuts, rods, building irons for houses, bridges, cold iron punching. In 1835 Mr. Smith worked for Phelps & Bickford, in Grove Street, and worked on the first looms built for William Crompton in this country.

J. Fred. Wilson, cold punched nuts, washers, chain links, etc.

Boot and Shoe Lasts.—Porter & Gardner, Foster Street.

Boot and Shoe Machinery.—John J. Adams, 85 Mechanic Street.

Box-Makers, (wood and paper).—Baker & Co., Foster Street; C. F. Darling, 66 Foster Street; J. W. Howe, 163 Union Street. C. W. Humphrey, 42 Southbridge Street, turns out from five thousand to six thousand paper boxes per day. The Whitcomb Envelope Company also make paper boxes.

Brewers.—There was a brewery in Worcester in 1822. Sixty-two and one-half cents a bushel was paid for barley delivered at the brewery. In 1827 the Worcester Distillery offers for sale New England rum, molasses, cider brandy, high wines.

Bowler Brothers, Quinsigamond Avenue, corner Lafayette Street, established the business of brewing ale and porter in 1883. They pay a larger tax to the United States Government than any one outside of Boston.

Brooms.—O. M. Dean, 170 Austin Street.

Brushes.—Ellis Thayer manufactured brushes in Worcester in 1849. In 1869 the firm became Thayer & Mason; in 1878 Mr. J. Fred. Mason became proprietor. He manufactures brushes of all descriptions.

Carders' Tools.—William H. Brown, 81 Mechanic Street, Lewis' patent card clamps, card ratchets, hammers, gauges, tools, scrapers, Kimball's patent card stretcher.

Clipping-Machines.—Coates' Clipper Manufacturing Company, 237 Chandler Street.

Copying-Presses.—R. E. Kidder, 35 Hermon Street. Also manufactures patent Universal Sewing-Machine.

Cotton.—H. W. Smith, Wachusett Mills, fine dress ginghams.

Court-Plaster.—C. B. Robbins, 76 Portland Street.

Curriers.—P. Corriveau, 32 Hermon Street.

William Leonard, 2 Sargent Street.

Curtain Poles and Rings.—Worcester Moulding Works, Foster Street.

Dental Instruments.—C. B. R. Claflin, 38 Front Street.

Die Cutter Stock.—Loring Coes & Co., manufacturers of machine knives, cutter plate for dies to leather, cloth and paper; moulding cutter-plate for wood, marble, etc.; all kinds and sizes of shear plates, and strips for cotton and woolen machinery.

L. Hardy & Co., manufacturers of machine knives, straight cutter ensilage, lawn-mower, meat-cutter, cork-cutter, rag-cutter and bone knives; shear-blades and strips for cotton and woolen goods. Also die cutter stock for boots and shoes; all kinds of welded stock rolled to any thickness from fourteen gauge to three-quarter inch thick. Wood-working machine-knives, planers, moulding-knives and blanks; paper-cutting, leather-splitting and stripping-knives.

Doors, Sash, Blinds, &c.—Charles Baker & Co., wholesale and retail lumber dealers; manufacture doors, windows, blinds, window and door frames, inside and outside ornamental finish from architects' plans. Yards at Manchester, Grove and Prescott Streets.

A. W. Joslyn, 181 Union Street.

George Peirce, 330 Park Avenue.

D. & C. P. Stevens & Co., 24 Southbridge Street.

Rice & Griffin Manufacturing Co., Sargent Street

William Ross, 138 Main Street.

DRAIN PIPE.—James Draper, drain sewer and well pipe, Bloomingdale.

A. B. Lovell, cement pipe.

S. E. Todd, Southbridge Street.

DRILL MANUFACTURERS.—Six in number, some of whom have already been mentioned.

George Burnham & Co., 15 Hermon Street, improved upright drills.

R. W. Long, successor to George C. Taft, No. 8 Harris Court, improved upright self-feed drills.

Lowell Wrench Company. Ratchet drills, ratchet wrenches.

Prentice Bros., 49 Hermon Street. Upright drills.

DROP FORGINGS.—Worcester Drop Forging Works, No. 30 Bradley Street. Quick-action vises; shuttle irons.

DRY PLATE MANUFACTURERS.—Phœnix Plate Company, manufacturers of Phœnix gelatine dry-plate, argentic plate for positive pictures, ebonized and maroon wood and metal panels; also japanned iron and tinned sheets of all sizes for painters and lithographers.

DYE-HOUSES.—In 1828 William B. Fox did dyeing of all kinds.

John H. Starkie, Layard Place.

Worcester Silk Co., 390 Main Street.

Worcester Bleach and Dye Works, dyers and bleachers of cotton, woolen and worsted yarns, threads, tapes, etc. Also black, white and fancy colored warps in chains and beams furnished to order in any desired pattern. Present location, Grove Street. After April 1, 1880, West Fremont Street, New Worcester.

EAVE TROUGHS.—A. Bangs & Co., 175 Union Street.

ELEVATORS, HYDRAULIC.—Washburn Shop, Polytechnic Institute.

Hydraulic Manufacturing Co., 23 Hermon Street.

Worcester Elevator Co., 47 Lagrange Street.

FAUCETS.—Worcester Faucet and Manufacturing Co. Self-closing faucet.

FERRULES.—Worcester Ferrule Manufacturing Co., manufacturers of steel and brass stove trimmings, patent nickel-plated knobs, hinge-pins, towel racks, foot-rails, steel, iron and brass ferrules, nickel-plated steam pipe collars. 17 Hermon Street.

John L. Parker & Co., manufacturers of patent seamless sheet-metal goods of every description, stove door-knobs, hinge pins, towel-rods, 70 School Street.

FILES.—William Hart, 5 Washington Square; established 1857, now employs seventeen hands. Largest manufacturer of hand-cut files in New England. A large number of files from the manufactories in the city are here re cut. Mr. Hart makes four hundred different shapes and sizes of files, and has a branch shop at Holyoke.

A. J. Hiscox.

FISHING-RODS.—N. S. Harrington, 72 Portland Street.

FRAMES FOR PICTURES.—G. S. Boutelle & Co., successors to Worcester Moulding Works. Also, picture-frame easels, fancy tables, etc.

FRICTION PULLEYS.—Blake Bros., manufacturers of the patent friction clutch, shafting, hangers and special machinery, Union Street.

GLUE.—John J. Jefferds, manufacturer of glue, tallow, ground bone, fertilizers. Works half a mile south of Quinsigamond, on Providence and Worcester Railroad.

GRINDING MACHINERY.—B. S. Roy, for card grinding.

Washburn Shops, for emery wheels.

GRIST-MILLS.—D. & C. P. Stevens & Son.

GROUND BEEF SCRAPS.—Charles F. Rugg, manufacturer of fine cylinder, engine, machinery and bolt oils. Best grade steam-rendered tallow and soap for manufacturers and family use. Dealer in paraffine, lard and neat's-foot oils. Pure ground beef scraps.

GUTTERS AND CONDUCTORS.—A. Bangs & Co., 175 Union Street, manufacturers of eaves troughs, &c.

J. B. Cummings, 197 Union Street.

HARDWARE MANUFACTURERS.—A. W. Gilford, 77 Beacon Street

Hill Dryer Co., 21 Hermon Street.

A. McDonald, 418 Main Street.

Morgan Spring Co., 25 Lincoln Street.

Wire Goods Co., 20 Union Street.

HEEL MANUFACTURERS.—E. D. Barrows & Son, 195 Front Street.

E. N. Dean, 194 Front Street.

A. D. Hall, 164 Front Street.

G. S. Hatch, 164 Front Street.

Myrick, Shepard & Co.

HOSIERY.—Holland Hosiery Company, 191 Front Street.

INK.—Levi R. Rockwood, 23 Orient Street.

LOOM REEDS.—For cotton, woolen, carpet and wire cloth mills, John Whittaker, 193 Front Street.

MILK CANS.—James H. Whittle, manufacture of tin cylinders of all diameters.

MOULDING-MACHINES.—Blake Brothers.

Witherby, Rugg & Richardson.

NAILS.—Somers Brothers. Tacks and Hungarian nails. Shoe tacks a specialty. Located here because of the large amount of boot making. Running seventeen machines. The only concern of the kind in the city. Uses tack-machines invented by Thomas Blanchard.

NEEDLES.—Worcester Needle Company, Sewing machine needles. In 1853, F. S. Cox made needles at South Worcester.

OVERALLS.—A. G. Hildreth, 21 Southbridge Street.

PERFORATED METALS.—Towne & Company, 81 Mechanic Street.

POTTERY.—F. B. Norton's Sons, Water Street. In 1784 there was a pottery in Worcester, two and a half miles from the meeting-house on the road to Springfield.

ROLLER SKATES.—The Samuel Winslow Skate Manufacturing Company. Ice and roller skates; gear cutting.

SAW MANUFACTORY.—E. D. Cunningham, 23 Hudson Street.

SHAFTING.—Holyoke Machine Company.

TAPES.—H. M. Witter & Company, Park Avenue.

TRUNKS—Barnard Brothers, 494 Main Street.

George L. Barr, 20 Front Street.

VALENTINES.—Bullard Art Publishing Company Main Street.

J. W. Taft, 35 Pearl Street.

George C. Whitney, Art Publisher and Importer; factory and main office, Worcester; also offices New York, Chicago and Boston.

VISES.—Worcester Drop Forging Work.

WASHERS.—Reed & Prince, makers of rivets, blanks for small screws, washers.

WATER METER.—In 1858 a water meter was invented by Dr. E. D. Wetherbee, and manufactured by D. Newton, gunsmith. Union Water Meter Company was established November, 1868, by Messrs. Fitts, John C. Otis, Phineas Ball; employs sixty hands. Their meters go all over the country, and some to England and Germany. The product is covered by patents.

YARNS.—The Edgeworth Mill, carpet yarns, Brussels Street.

Artificial stone is manufactured by C. F. Green & Company, Sargent Street. The stone is made of sand and cement, and is used for building purposes; chimney caps, thimbles, etc. This is a continuation of the business known as the Frear Stone Works.

E. J. Kerns manufactures a patent rowlock; also roller seats for boats. Some of these have been sent to foreign countries.

CHAPTER X.

MANUFACTURING AND MECHANICAL INDUSTRIES.

Reasons for Worcester's Prominence as a Manufacturing City—Room with Power for Rent—Merrifield Building—Heywood Building—Estabrook Building—Enterprise of Worcester's Business Men—Mechanics' Association—Worcester Polytechnic Institute—Washburn Shops—The Laboring Classes—Evening Schools—Worcester's Rapid Growth—Heart of the Commonwealth.

IT has frequently been said that Worcester owes her prominence as a manufacturing centre to the unusual opportunities offered to mechanics to begin business in a small way, and without incurring the risk incident upon the erection and equipment of a shop. Indeed, had this not been the case, individuals, companies and corporations doing to-day a prosperous business would never have started. Many instances might be given of individuals who have begun with one machine, gradually increasing their business out of the profits realized from day to day, until it has reached considerable magnitude. Growth of this kind is healthy and likely to be permanent.

It would be almost literally true to say that there is no large manufacturing business in Worcester that has not at some time in its history been situated in one or another of the buildings erected for rent with power to a number of tenants. There are some exceptions, but they are few. An idea of the number of industries begun in this way may be obtained by noticing the occupants of the buildings erected for the accommodation of those engaging in mechanical pursuits.

The old Court Mill had been built some years when, in 1832, Samuel Davis leased it from Mr. Salisbury. Among the tenants here at one time or another were L. & A. G. Coes, builders of woolen-spinning machinery, and subsequently, manufacturers of wrenches; Ruggles, Nourse & Mason, manufacturers of agricultural implements; H. W. Miller, punching-machines for manufacturing nuts and washers; Thomas E. Daniels, builder of the planing-machine; Samuel Flagg, pioneer in the machinists' tools business in Worcester. The old building was burned in October, 1839, and Mr. Salisbury made a contract with W. T. Merrifield to rebuild the mill by January 1, 1840, for Ruggles, Nourse & Mason threatened to move out of town unless it were finished by that time. After the foundations were in, Mr. Salisbury thought the building could not be completed in the winter, and offered to release Mr. Merrifield from the contract, but Mr. Merrifield went ahead, although Worcester masons refused to lay brick in the winter, and he was compelled to bring masons from Boston to do the work. The building was completed by January 1st.

Then came the Dr. Heywood building in Central Street, occupied by a number of firms, among them Samuel Flagg & Company and S. C. Coombs & Company, who established the business now conducted by the Lathe & Morse Tool Company. Mr. Merrifield occupied his present location in 1835; soon after he used a horse to furnish power to run a circular saw and a Daniels planer. In 1840 he put in an engine. The first brick building for tenants was erected in 1847, and additions were made to it every year until the fire of 1851, when the following were among the occupants: William R. Bliss, bootmaker; Town & Company, perforated board; Hovey & Lazell, straw-cutters; E. F. Dixon, wrenches; Lamb & Foster, carpenters; Williams, Rich & Company, machinists; Samuel Flagg & Company, machinists' tools; Prouty & Allen, shoe tacks; Daniel Tainter, wool machin-

ery; C. Hovey & Company, straw-cutters; C. Whitcomb & Company, machinists' tools; Charles E. Wilder, boot and shoe-machines; H. Palmer & Company, box-maker; Towne & Harrington, portemonnaies; N. B. Jewett, seraphine-maker; Thayer, Houghton & Company, machinists' tools; Furbush & Crompton, fancy looms; Richards & Smith, sash and blinds; Luther White, machinist; F. J. Gouche, plane-maker; Isaac Fiske, musical instruments; A. Sampson, wheelwright; S. G. Reed, wheelwright; Worcester Knitting Company; Worcester Machine Company; George Dryden, machinist; Hood, Battell & Company, sewing-machines; Edward Lawrence, tool-maker; Daniel Palmer, box-maker; Howard Holden, grist-mill; Rodney A. M. Johnson & Company, wool-spinning machinery.

When rebuilt, the buildings measured over eleven hundred feet in length, fifty feet in width, and three stories in height; the area of the floors was over four acres and a half; the power was obtained from a three hundred and fifty horse-power engine, the same which is running to-day. In 1859 Mr. Merrifield had leased rooms and power in his buildings to over fifty firms, each employing from two to eighty hands. Among them:—

Alzirus Brown, on the corner of Union and Exchange Streets, who, with fifty hands, engaged in the manufacture of Manny's Patent Mower and Reaper combined. Daniel Tainter, in Union Street, employed thirty hands in making woolen-carding machines and jacks. Johnson & Co. employed twenty hands making jacks for woolen machinery. Richardson & Mawhinney, in the same street, employed twenty-four hands on lasts and boot-trees. L. W. Pond occupied about two hundred feet of the first floor, under the preceding, for the manufacture of engine-lathes, planing-machines, etc., employing twenty-seven hands. He had a lathe thirty-seven feet long, capable of cutting screws of any length from one to thirty-three feet. He also used the largest and heaviest planing-machine in the city, thirty-seven feet long, six feet wide and four feet high, weighing forty tons.

Prouty & Allen, in the room north of Mr. Pond, employed from five to six hands in making iron or zinc shoe-nails, of which they turned off from one thousand to twelve hundred pounds per day. Battelle & Co., in the third story, had five hands engaged in the manufacture of sewing-machines. J. L. & I. N. Keyes, on the east side of Union Street, did an extensive business, with eighteen hands, in board-planing. Hamilton Holt, in rooms over them, had four hands engaged in making patent gutters, or conductors of water from the roofs of buildings. C. Whitcomb & Co. were doing a good business making machinists' tools and letter-copying presses, and employed fifteen hands. Towne & Harrington, with ten hands, made mowing-machine knives. Dresser & Wilson had about six hands making Jillson's patent animal-traps, manufacturing two hundred per day. S. G. Reed & Co., in Cypress Street, employed twenty hands in making carriage-wheels and wheel-spokes of all kinds.

George F. Rice, employed ten hands in the manufacture of Hovey's patent hay-cutters, corn-shellers and winnowing-mills, and a very superior article of boring-machine of his own invention. Joel W. Upham had from six to eight hands engaged in making very large water-wheels for manufacturing establishments, averaging from twenty to thirty per year. Isaac Fiske employed six hands making musical wind instruments. D. D. Allen & Co. manufactured boot forms. S. C. & S. Winslow employed from six to twelve hands in gear-cutting and light jobbing. Thomas Smith & Co. had four hands making patent bit-pieces and doing cold punching. The Machine Lathe Company in Exchange Street, of which Jason Chapin was president and A. L. Burbank treasurer, employed seven hands making bedstead lathes and in iron job-work. Charles E. Staples, with seven hands, made bit-stocks and window-springs and did light jobbing. Charles E. Wilder had a few hands in the manufacture of boot-crimping machines. Franklin Wesson had three hands in the gun manufacture. P. Goulding with six hands, on the opposite side of the street, made thirty dozen of shuttles per week. U. T. and C. H. Smith made chair-lathes and did jobbing, employing four hands. William H. Brown had a jobbing shop with three or more hands.

Meantime Colonel James Estabrook and Charles Wood, in 1851, erected the stone building at the Junction now occupied by the Knowles' Loom Works. Wood, Light & Co. were to occupy part of it, which they did, and the rest of the building was to be rented to tenants. Shepard, Lathe & Co. moved into the north end of the building very shortly after the occupancy of Wood, Light & Co. In 1857 Mr. Wood disposed of his interest to Colonel Estabrook.

The main building was four hundred and fifty feet long by fifty feet wide, and three stories high; another building used for a forge shop and other work, two hundred by forty; power was furnished by two fifty horse-power engines, made by Corliss & Nightingale, of Providence. Among the tenants were Wood, Light & Co., who occupied the two lower stories in the south end of the main building for the manufacture of machinists' tools, water wheels, mill works, castings. J. A. Fay & Co. occupied a hundred feet on the second floor, manufacturing wood-working machinery, employing thirty hands. Joseph Barrett & Co., in the south end of the second floor, employed twenty hands in the manufacture of calico-printing machinery, Woodworth's planing-machines, machinists' tools, etc. Shepard, Lathe & Morse occupied one hundred feet of the first floor under the preceding, and manufactured engine-lathes and iron planing machines. Whittemore Brothers, in the upper story, employed twenty hands in manufacturing machines for paring, coring and slicing apples. The American

Steam Music Company manufactured calliopes and terpsichoreans. Heywood & March made Holbrook's automatic bank-locks. David McFarland made card-setting machines. A. F. Henshaw manufactured machinists' tools and bonnet machinery.

The means thus afforded to individuals with limited capital to begin manufacturing unencumbered with an expensive plant, making it possible for a small business to be conducted with profit, is one of the chief causes of the diversity of industries which makes Worcester uniformly prosperous, and creates a thrifty and permanent class of working-people.

In striking contrast are some other New England cities, confined almost entirely to a single industry, and with a large unsettled population of mill operatives, the business conducted by corporations, owned by non-resident stockholders and under a non-resident management. With such conditions, the prosperity of the community is uncertain, largely a matter of chance. In good years the dividends declared are not invested where they are earned, while in bad years the immediate community suffers, want soon overtakes the working-people, and crime follows in the wake of cold and hunger.

It is true that there are corporations in Worcester, but they are, almost without exception, the outgrowth of individual enterprise; the stockholders are residents, and in many cases, employes; the dividends are largely invested in real estate, in business blocks, in tenements, in factory property, while the fortunes accumulated found our hospitals, homes for the aged and infirm, build our churches, endow our schools.

While there are few large fortunes here, there are many small ones. There is, perhaps, less of luxury and display than in some communities, but more of thrift.

To properly take advantage of the opportunities here offered, an intelligent people was needed. Enterprise and sagacity have always been characteristics of the business-men of Worcester—early manifested in appreciation of communication with the sea-board, and secured by the building of the Blackstone Canal, and evidenced later in the building of the railroads, and always recognized in the high reputation enjoyed throughout the country by our manufactures.

But there is better evidence than this of the wisdom and foresight of the men who laid the foundation of Worcester's prosperity.

A desire for opportunities for education was manifest at a very early day. About 1819 a number of young mechanics, who had been active in reforming the schools and establishing a lyceum and temperance society, made an attempt to form a mechanics' association. This failed; but November 27, 1841, a public meeting was held to consider the question. Ichabod Washburn was chairman, and Albert Tolman secretary of this meeting. A committee was chosen, consisting of Anthony Chase, William Leggatt, Henry W. Miller, William M. Bickford, Putnam W. Taft, Levi A. Dowley, William A. Wheeler, Rufus D. Dunbar, John P. Kettell, James S. Woodworth, Albert Tolman, Hiram Gorham, Joseph Pratt, Henry Goulding and Edward B. Rice, to consider the formation of an association having for its object "the moral, intellectual and social improvement of its members, the perfection of the mechanic arts and the pecuniary assistance of the needy."

The first meeting of the subscribers was held February 5, 1842. William A. Wheeler was elected president; Ichabod Washburn, vice-president; Albert Tolman, secretary, and Elbridge G. Partridge treasurer. Steps were taken to establish a library and an annual course of lectures. The first lecture was delivered by Elihu Burritt (then a resident of Worcester), and was upon the importance of educating the mechanics and workingmen of the country. From that time to the present the Mechanics' Association has provided a course of lectures every winter.

Another object in forming the association was the holding of an annual fair for the exhibition of the mechanical products of the city. The first fair was held in September, 1848, and was very successful. The reports of the judges were printed and widely circulated, creating a wide knowledge and consequently large demand for the products of Worcester mechanics. In July, 1854, in commenting upon the association and its work, the statement was made: "Notwithstanding the inadequate supply of water-power, which is everywhere deemed so essential for the successful development of the mechanic arts, without the aid of a single act of incorporation, mechanical business has increased in this city by individual enterprise alone more than tenfold. The mechanics as a class are more enlightened and better educated than formerly; their course is onward and upward; they are not only increasing in numbers, but continually expanding in influence and usefulness. Instead of being a small fraction of the population of a town of two or three thousand, as they once were, they are nearly a majority of the population of a city of twenty-two thousand; are the owners of nearly or quite half of the taxable real estate, and are producing from their workshops more than six millions of dollars annually. Their reputation for variety, excellence and finish on all labor-saving machines and implements extends far and wide through the land. Their products, branded with the name of some enterprising firm in Worcester, may be found in the shops, mills and factories and on the farms of every State in the Union."

In 1850 an act of incorporation was obtained from the State, and May 4, 1854, Ichabod Washburn offered to give ten thousand dollars towards the purchase of land and the erection of a Mechanics' Hall, provided an equal sum should be raised by the association. The offer was accepted and the condition complied with. In addition to the twenty thousand dollars

thus raised, the association issued bonds to the amount of fifty thousand dollars, secured by mortgage upon the property, and further sums were raised as the work advanced, of which amount nearly forty-four thousand dollars was taken and paid for by two hundred and fifty-six members of the association. Ground was broken July, 1855, and on the 3d of September the corner-stone was laid, the day being observed as a holiday. The building was completed in 1857, and was dedicated March 19th of that year.

Another and striking illustration of the interest taken by the manufacturers and mechanics of Worcester in educational affairs is found in their generous contributions toward the building and endowment fund of the Worcester Polytechnic Institute, a school free to residents of Worcester County.

The founder, John Boynton, of Templeton, provided that the school should be located in Worcester, if the citizens would furnish the funds necessary to purchase a lot and erect suitable buildings. This condition was complied with, and among the contributors were workmen in twenty of the then (1868) largest shops and factories.

At the same time Ichabod Washburn built, equipped and endowed a machine-shop, connected with the institute, in which students were to be taught the practical manipulation of tools. This conception of a school-shop is unique. The maximum number planned for by the founder to be instructed at any one time was twenty. For the past five years over one hundred pupils have received instruction each year.

Meantime the schools of the city have increased in number and efficiency. No child, however poor, need be deprived of a thorough education, free of any cost for instruction, and in the public schools being even relieved of the expense of buying books.

Up to 1840 manual labor in our shops was, for the most part, performed by Americans. Worcester naturally attracted boys from the country, and the farmers' sons became our mechanics.

About this time Irish emigration commenced and, as the heavier kinds of manufacture were introduced, the Irishman became an important factor in our industrial development and indispensable to our material progress.

Since 1880 a large Scandinavian population has been added to Worcester, probably not less than six thousand or seven thousand men, women and children, of which about three thousand are men and boys. They are thrifty, industrious, capable and law abiding people, who have come to make this country their home. They are found in most of our shops and are employed exclusively in some of them. They support five churches, in which their own language is spoken. Their children attend the public schools; in 1887 the number of children was five hundred and seventy-four.

Another element in our population is the Armenian. There are at the present time about four hundred Armenians in Worcester, the larger number from the province of Harpoot. Very few of them have had any mechanical training, having been engaged, in their own country, in agricultural pursuits, either as peasant farmers or as laborers for farmers. This occupation affords scarcely more than a bare subsistence, the wages being from twenty cents to thirty cents per day. Some of the Armenians intend remaining here and are gathering their families about them. Two-thirds of those now here have been assisted in their emigration by the earlier third. None of the Armenians would contemplate a permanent return to their own country, if assured of work. They are timidly cautious, and do not wish to send for their families until they have earned the means to sustain them for an extended time. They are convinced that a knowledge of the English language is essential and are anxious to improve their opportunities for acquiring it.

The evening schools are invaluable in giving our large foreign adult population an opportunity to acquire sufficient education to become useful and intelligent citizens. An examination of the records shows that out of 691 who attended the evening schools during the past year (1888), 165 were Irish, 155 Armenians, 153 Scandinavians, 111 French, 45 English, 31 American, 14 Poles, 12 Germans, 3 Mexican, 1 Scotch, 1 Portuguese.

These schools are maintained at a cost for each pupil of $11.68 for the year.

It is an interesting fact that no Scandinavian has ever made application to attend evening school who could not write his name.

At the evening drawing-schools opportunity is afforded to learn free-hand drawing and drafting, of which our intelligent mechanics are quick to avail themselves. The average attendance during the year 1888 was one hundred and thirty-nine.

According to the census of 1885, there were seven hundred and seventy-two establishments engaged in manufacturing and mechanical industries in the city of Worcester; the total capital invested, $18,344,408; value of stock used in a year, $15,016,756; total value of goods made and work done, $28,699,524, the different industries standing in the following order:—Metallic goods, other than iron; boots, shoes and slippers; iron goods; wood and metal goods; building material for building and stone-work; textiles; food preparations; miscellaneous clothing and straw goods; woolen goods; paper and paper goods; leather; printing and publishing; paints, colors, oils and chemicals.

June 30, 1885, there were employed in manufacturing and mechanical industries 16,566 people—13,413 males, 3153 females—of which 2175 were under twenty-one, and 14,091 twenty one and over; 10,512 of these work by the day, and 6051 by the piece.

The total amount paid in wages in the census year was $7,050,755.

Worcester has developed from a country town to a large manufacturing city in less than sixty years. The population in 1830 was a little over four thousand, and to-day is probably eighty thousand.

Within that time the steam-engine, the railroad, telegraph and telephone have enormously increased the productive power of labor. The improvement in the condition of the laboring classes is no less marked; contrary to the opinion once held, the introduction of labor-saving machinery has advanced instead of lowering wages; has reduced, instead of extending the hours of labor. The laborer receives a constantly-increasing proportion, the capitalist a constantly-decreasing proportion in the division of gains. Many of our mechanics own their homes, and are naturally deeply interested in the welfare of the city. Avenues for advancement are always open to the capable and industrious. From their ranks will come the leading business men of the next generation, upon whom the continuance of prosperity will depend.

It is worthy of note that the causes of Worcester's prosperity are found within and not without. No abnormal conditions have prevailed, a change in which can bring disaster. No Government works or patronage of any kind have contributed to her advancement. We need not fear the natural advantages of other sections of the country, for there must always be conducted here the manufacture of the finer grade of goods, requiring intelligent and delicate manipulation. As we review the past and forecast the future, we can but feel that Worcester is worthy of her civic seal,—THE HEART OF THE COMMONWEALTH.

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